

CHAPTER 1 INTRODUCTION

1.1 Background [1]

In recent years, head and neck cancer impacts Thai patients that it involves the skin, soft tissue and/or bones of the head and neck region. The head and neck cancer may result in head and neck dysfunction, disfigurement and psychosocial problems. General treatments for head and neck cancer are surgery, radiation therapy and chemotherapy. Early positioning and immobilization aids consisted of sandbags, foam sponges, rolled linen and masking tape. Patients were positioned on the treatment table with these aids, then anatomical landmarks and body planes were used to establish a reproducible position. However, these aids did not meet the technical accuracy for all treatment techniques. Therefore, investigation of new methods and materials started improving patient positioning. Sandbags and rolled linen were replaced with contoured styrofoam head and neck rests. Varied sizes were evaluated and a common set was established and manufactured in hard foam covered with rubber. However, there was still room for improvement. Thermoplastic was discovered from occupational therapy and integrated into radiation therapy for head and neck contoured masks attached to standard bases with use of the headrests. Positioning lasers added to the improved accuracy in treatment positioning reproducibility.

A thermoplastic mask consists of two parts; a rigid frame and a sheet of thermoplastic. Some masks come pre-attached to the frame and others must snap into the frame. When the mask is placed in warm water the thermoplastic becomes soft and pliable. Then it is pulled over the patient and is molded to the contours of the patient anatomy. As the mask cools a rigid replication of the patient anatomy is created. Thermoplastic masks are available in both head-only or head, neck and shoulder styles. The clinical team will choose the most appropriate mask for treatment. To achieve the most successful radiation therapy treatment, it is important to have the radiation beam hit the tumor every time, while sparing as many healthy cells around the tumor as possible. To achieve this, the patient needs to be in the same position every time he or she is treated. A thermoplastic mask aids in immobilizing the patient during treatment as well as repositioning the patient from treatment to treatment. The mask can also be marked so the patient can be aligned with the room lasers, which may eliminate the need to mark on the patient's skin.

In this work, the polymer blends of polybutylene succinate (PBS) and ethylene vinyl acetate (EVA) were used to prepare thermoplastic masks for radiotherapy. Find the appropriate ratio of polymer blend, and compare the polymer blend specimens with the thermoplastic masks in hospital use. Moreover, the plasticizer will be added to improve the mechanical properties of the polymer blends.

1.2 Research Objectives

1. To prepare the thermoplastic masks for medical applications by using PBS and EVA.
2. To find the appropriate ratio between PBS/EVA.
3. To improve properties of thermoplastic masks by adding triacetin as a plasticizer.
4. To study effects of irradiation on thermoplastic mask.

1.3 Scope of Work

1. PBS and EVA are used to prepare the thermoplastic mask.
2. To find the optimal ratio of the polymer blend of PBS/EVA.
3. Plasticizer will be used to offer better mechanical properties.
4. Mechanical and thermal properties are measured for specimen test.
5. Equipments used in this work are:
 - Twin screw extruder
 - Injection molding machine
 - Differential Scanning Calorimeter (DSC)
 - Scanning Electron Microscope (SEM)
 - Fourier Transform Infrared Spectroscopy (FTIR)
 - Universal testing machine

1.4 Expected Result

The preparation of thermoplastic masks by using polymer blend can develop better properties or improve the existing ones to give specific property needs. The polymer additives can be added to modify polymers for radiotherapy. In addition, the usage of polybutylene succinate, which is biodegradable polymer, will be also friendly to the environment.

CHAPTER 2 LITERATURE REVIEW AND THEORIES

2.1 Literature Review

Leah et al. [2] had used 2 different immobilization systems for patients requiring radiotherapy to the head-and-neck region. A polycarbonate mask was manufactured for radical treatments and a thermoplastic mask for palliative treatments. This study evaluated field placement accuracy, staff opinion, and production costs of both systems. The manual matching program of Varian Portal Vision Electronic Portal Imaging (EPI) System was used to assess field placement accuracy on a daily basis. Radiation therapists (RTs) were surveyed before and after the study to determine their opinions of each system. Production time and required materials were recorded to assess cost. Nineteen patients from each system had daily EPI results compiled with no statistically significant difference observed in field placement accuracy. The thermoplastic system was found to be more cost efficient due to a combination of the reduced production time and reuseability of the masks. User acceptability of the thermoplastic system has increased so that it is now the preferred system. In conclusion, the thermoplastic system is a viable alternative to the polycarbonate system in terms of treatment accuracy and cost. It is recommended that the thermoplastic system be used for all radical and palliative treatments. In addition, RTs prefer the thermoplastic system.

Caroline et al. [3] had studied two widely used immobilization systems for head fixation during radiotherapy treatment for ear-nose-throat (ENT) tumors are evaluated. The masks made of polyvinyl chloride (PVC) are compared to thermoplastic masks (Orfit) with respect to the accuracy of the treatment setup and the costs. For both types of material, a cut-out (windows corresponding to treatment fields) and a full mask (not cut out) are considered. Forty-three patients treated for ENT tumors were randomized into four groups, to be fixed by one of the following modalities: cut-out plastic mask (12 patients), full plastic mask (11 patients), cut-out Orfit mask (10 patients), and full Orfit mask (10 patients). It was found that Orfit masks are a cheaper alternative than plastic masks; they require much less investment expenses and the workload and material cost of the first mask for each patient is also lower. Cut-out masks are more expensive than full masks, because of the higher workload and the additional material required for second and third masks that are required in case of field modifications. Moreover, it was found that no substantial difference in patient setup accuracy between both types of masks was detected, and cutting out the masks had no impact on the fixing capabilities. A first Orfit mask will typically be a cheaper alternative than a plastic mask for most departments (lower fixed and variable costs). The higher material cost of the subsequent Orfit masks, compared to the plastic masks, offset the lower investment expenses.

Russell et al. [4] had studied a new orthopedic casting material has been adapted to use for immobilizing patients undergoing radiation therapy. The material has proven to be less cumbersome and time-consuming than other products currently in use. The necessary equipment and procedures required to form an immobilization cast using thermal plastic material.

Marcus et al. [5] had studied the most precise immobilization of the patient's head is indispensable in order to reach a high degree of exactness and reproducibility in radiotherapy of malignant head and neck tumors. The face masks made of different synthetic materials have proved to be a simple and economical solution for this problem. Eleven substances have been tested in the phantom (compound of plaster and synthetic resin, thermoplast, polyurethane foam, compounds of cotton and synthetic resin, and fibre glass compounds). An appropriate material was thermoplast, a reticulated thermoplast which after warming up can be easily adapted to the patient's face and which guarantees a very good fixation of the head. As compared to solid masks, there is only a slight superposition of the depth dose of Co-60 gamma radiation by secondary electrons from the mask material, so that an increased rate of radiogenic dermatitides is not to be expected.

Lena et al. [6] had compared two types of Posicast thermoplastic face masks, in terms of reproducibility, patient comfort, tolerability, and skin damage. The patients were randomly assigned to use a head mask (HM) or a head-and-shoulder mask (HSM). Three-dimensional treatment planning was followed by fractionated external-beam radiation therapy. Reproducibility was assessed by comparing port films with simulator films twice during treatment and by comparing actual treatment table positions weekly. Patient tolerability and comfort were studied weekly. The radiation-induced skin damage was assessed every week according to the World Health Organization toxicity scale. A total of 260 patients were included, and 241 (93%) were evaluated. There were no statistically significant differences between the groups (HM or HSM) in terms of reproducibility. Patients using HSM experienced significantly more claustrophobia ($p = 0.023$). Patients allocated to HSM receiving ≥ 60 Gy were found to have more skin reactions. The results was found that the smaller HM reduced feelings of claustrophobia, as well as skin reactions, for patients receiving ≥ 60 Gy. The smaller mask did not compromise the reproducibility of the setup.

Xu et al. [7] had studied the physical properties of PBS and its copolymers, which are a family of biodegradable polymers with excellent biodegradability, thermoplastic processability and balanced mechanical properties. In this article, production of the monomers succinic acid and butanediol, synthesis, processing and properties of PBS and its copolymers are reviewed. The physical properties and biodegradation rate of PBS materials can be varied in a wide range through copolymerization with different types and various contents of monomers. PBS has a wide temperature window for

thermoplastic processing, which makes the resin suitable for extrusion, injection molding, thermoforming and film blowing.

Bhatia et al. [8] had studied the compatibility of PLA and PBS with various compositions were prepared by using a laboratory-scale twin-screw extruder at 180°C. Morphological, thermal, rheological and mechanical properties were investigated on the samples obtained by compression molding to explore suitability of these compositions for packaging applications. Modulated differential scanning calorimetry (MDSC) thermograms of the blends indicated that the glass transition temperature (T_g) of PLA did not change much with the addition of PBS, but analysis showed that for PLA/PBS blend of up to 80/20 composition there is compatibility between the two polymers. The tensile strength and modulus were measured by the Instron Universal Testing Machine. Tensile strength, modulus and percentage elongation at break of the blends decreased with PBS content. However, tensile strength and modulus values of PLA/PBS blend for up to 80/20 composition nearly follow the mixing rule. Rheological results also show compatibility between the two polymers for PBS composition less than 20% by weight. PBS reduced the brittleness of PLA, thus making it a contender to replace plastics for packaging applications. This work found a partial compatibility between PBS and PLA by investigating thermal, mechanical and morphological properties.

Donjai Ruangrit [9] had studied the appropriate polymer for preparation of thermoplastic masks for medical applications. The results indicated that the type of polymer being used is polycaprolactone. The tensile strength, Young's modulus and percentage elongation at break of the commercial thermoplastic mask were 17.35 MPa, 170.87 MPa and 387.51, respectively. The polymers used for preparing the masks in this study were polycaprolactone (PCL), polyvinyl chloride (PVC) and polycarbonate (PC). The PVC compound was prepared by mixing on a two roll mill using di-2-ethylhexyl phthalate (DEHP) as a plasticizer. The concentration of DEHP was varied from 8 to 25 phr. From the results, it was found that the optimum PVC compound is that obtained by using 18-25 phr of DEHP. The PC compound was prepared in twin-screw extruder using trioctyltrimellitate (TOTM) as a plasticizer. The concentration of TOTM was varied from 20 to 80 phr. From the results, it was found that the optimum PC compound is that obtained by using 75-80 phr of TOTM. Finally, the PCL compound was prepared in twin-screw extruder using 25 phr of high density polyethylene (HDPE), 73 phr of PCL, 2 phr of triallylcyanoate as a crosslink enhance and 2 phr of Irganox 1010 antioxidant gave the optimum PCL compound.

Mansor et al. [10] had studied the biodegradable composites material from polylactic acid (PLA) and dried tapioca starch were prepared by melt blending technique. The effect of addition of 1-10 % triacetin as external plasticizer on the 70/30 PLA/starch composite. The tensile strength and elongation at break of the 70/30 PLA/starch blend improved with addition of 5% triacetin but the tensile modulus decreased due to the plasticizing effect.

Jiazhen et al. [11] had studied the polymer fluoropolyimide is crosslinked by gamma-irradiation at high temperature. After crosslinking, the glass transition temperature is increased with increasing dose. High temperature tensile strength is also increased with increasing dose. The high temperature water resistance property is improved markedly. The results show that the fluoro-atom was decreased during radiation crosslinking. For the irradiation at room temperature, it can be crosslinked by irradiation at high temperature. This dramatically improves their subsequent radiation resistance. As a result it had also been able to achieve improved radiation resistance by irradiation of certain blends of a predominantly scissioning polymer with a predominantly crosslinking polymer. Further the radiation dose is higher than 10 kGy, the degradation effect on the polymeric material can be occurred.

2.2 Theories

2.2.1 Radiotherapy Masks [12]

Radiotherapy is the use of x-rays (and other rays) to treat cancer. Radiotherapy has to be aimed very precisely to make sure that exactly the right area of the body is treated each time. It's important that a person having radiotherapy lies still while the treatment is in progress. This is because any movement could change the area that gets treated.

When radiotherapy is given to treat tumors of the head and neck area or brain tumors, it is even more important to be as still as possible. To help with this, a radiotherapy mask (sometimes called a mold, a head shell or a cast) is made to be worn during the treatment. Once the mask is fitted, it is fixed to the radiotherapy treatment table (as shown in Figure 2.1). This ensures that your head and neck are held in exactly the right position for the treatment.



Figure 2.1 Radiotherapy mask

The mask is made in the mold room of the radiotherapy department by a mold technician or radiographer. The process of making the mask can vary slightly between hospitals but it usually takes about 30 minutes. One technique uses wet plaster bandages and the finished mask is made of perspex. The other technique uses a type of mesh plastic, which is molded to fit the shape of your face. If you have a beard, you will need to trim it or shave it off before the mask is made. You will also need to have your hair cut before the mask is made. This is to ensure that the shape of your face or head stays the same during treatment. If the shape changes, a new mask need to be made, which can delay treatment.

Wearing a mask can reduce the possibility of any movement while the radiotherapy is given. The mask is only worn during the planning procedures and during the treatment itself, which is usually for around 10-15 minutes at a time each day. Patients will not have to wear the mask at any other time.

Thermoplastic fixation masks will be completely softened in about 2-3 minutes, as being heated in hot water of 75°C (165°F). The completely softened material becomes

transparent. Complete softening facilitates the modeling and fixing of the material, and it makes the patients more comfortable in the process of modeling (as shown in Figure 2.2). Possess memorial feature. They can be used and modeled repeatedly. As needs to be remodeled and refixed, the stretched and transformed material can be put into hot water of 75°C to be softened again. In the process of softening, the heat activates and releases the frozen internal stress, so the material retracts and returns to its original shape. This reuse process is the most outstanding property of this material. The thermoplastic mask can be reused for several patients (3-5 times).

2.2.2 Thermoplastic Mask Instruction [13]

Warming – before beginning the warming process make sure that the water bath is at the temperature specified in the user manual. Using water which is not the correct temperature can contribute significantly to uneven holes pattern in the mask once it is pulled. Once the water bath is at the proper temperature place the thermoplastic in the water. Follow the heating times outlined in the thermoplastic mask manual. Under or overheating the mask can compromise the quality of the mask.

Forming thermoplastics – when thermoplastic has been in the water bath for the appropriate amount of time, pull it out of the water and remove excess water from the thermoplastic mask. Carefully form the thermoplastic over the patient and dock the mask onto the baseplate. Gently form the thermoplastic around the bony anatomy of the patient such as the nasion and chin. Make sure the thermoplastic is lying evenly on the patient’s skin and the patient is still in the desired position for treatment.

Cooling and storing – it is important to completely cool thermoplastics before removing them from the patient. Heat in the thermoplastic indicates it hasn’t finished setting. Removing thermoplastics while still warm may result in additional shrinking as the heat dissipates from the mask without the benefit of an anatomical stopping point. Remove thermoplastic by turning swivel clamps or disengaging T-Pins. Holding the frame to the table while pulling the T-Pin will ease disengagement. Finally, thermoplastics should be stored safely and at room temperature until they are no longer needed for the patient.

2.2.3 Thermoplastic [14]

Thermoplastic, also known as a thermosoftening plastic, is a polymer that turns to a liquid when heated and freezed to a rigid state when cooled sufficiently. Most thermoplastics are high-molecular-weight polymers whose chains associate through weak Van der Waals forces (polyethylene); stronger dipole-dipole interactions and hydrogen bonding (nylon); or even stacking of aromatic rings (polystyrene). Thermoplastic polymers differ from thermosetting polymers (e.g. phenolics, epoxies) in that they can be remelted and remolded. Many thermoplastic materials are addition polymers; e.g., vinyl chain-growth polymers such as polyethylene and polypropylene;

others are productions of condensation or other forms of polymerization, such as the polyamides or polyester.

Thermoplastics are elastic and flexible due to the strain from man is turban above a glass transition temperature (T_g) specific for each one (the midpoint of a temperature range in contrast to the sharp melting point of a pure crystalline substance like water). Below a second, higher melting temperature (T_m), also the midpoint of a range, some thermoplastics have crystalline regions alternating with amorphous regions in which the chains approximate random coils. The amorphous regions contribute elasticity and the crystalline regions contribute strength and rigidity, as is also the case for non-thermoplastic fibrous proteins such as silk (elasticity does not mean they are particularly stretchy; e.g., polyamides/Nylons rope and fishing line). Above T_m all crystalline structure disappears and the chains become randomly inter dispersed. As the temperature increases above T_m , viscosity gradually decreases without any distinct phase change.

Some thermoplastics normally do not crystallize; they are termed amorphous plastics and are useful at temperatures below the T_g . They are frequently used in applications where clarity is important. Some typical examples of amorphous thermoplastics are PMMA, PS and PC. Generally, amorphous thermoplastics are less chemically resistant and can be subject to environmental stress cracking. Thermoplastics will crystallize to a certain extent and are called "semi-crystalline" for this reason. Typical semi-crystalline thermoplastics are PE, PP, PBT and PET. The speed and extent to which crystallization can occur depends in part on the flexibility of the polymer chain. Semi-crystalline thermoplastics are more resistant to solvents and other chemicals. If the crystallites are larger than the wavelength of light, the thermoplastic is hazy or opaque. Semi-crystalline thermoplastics become less brittle above T_g . If a plastic with otherwise desirable properties has too high a T_g , it can often be lowered by adding a relatively low molecular weight plasticizer to the melt before forming (plastics extrusion; molding) and cooling. A similar result can sometimes be achieved by adding non-reactive side chains to the monomers before polymerization. Both methods make the polymer chains stand off a bit from one another. Before the introduction of plasticizers, plastic automobile parts often cracked in cold winter weather. Another method of lowering T_g (or raising T_m) is to incorporate the original plastic into a copolymer, as with graft copolymers of polystyrene, or into a composite material. Lowering T_g is not the only way to reduce brittleness. Drawing (and similar processes that stretch or orient the molecules) or increasing the length of the polymer chains also decrease brittleness.

Thermoplastics can go through melting/freezing cycles repeatedly and the fact that they can be reshaped upon reheating gives them their name. This quality makes thermoplastics recyclable. The processes required for recycling vary with the thermoplastic. The plastics used for soda bottles are a common example of thermoplastics that can be and are widely recycled. Animal horn, made of the protein α -

keratin, softens on heating, is somewhat reshapable, and may be regarded as a natural, quasi-thermoplastic material. Although modestly vulcanized natural and synthetic rubbers are stretchy, they are elastomeric thermosets, not thermoplastics. Each has its own T_g , and will crack and shatter when cold enough so that the crosslinked polymer chains can no longer move relative to one another. But they have no T_m and will decompose at high temperatures rather than melt. Recently, thermoplastic elastomers have become available.

2.2.4 Polybutylene Succinate [15]

Polybutylene succinate (PBS) is synthetic polyester having structure as shown in Figure 2.2. It is produced from succinic acid and 1,4-butanediol; both monomers can be prepared from petrochemical products and natural raw materials through the process fermenting starch and sugar into succinic Acid.

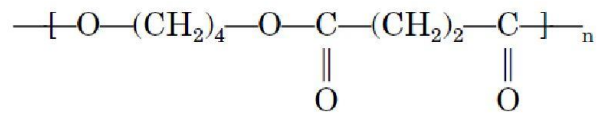


Figure 2.2 Structure of polybutylene succinate

The acid is used as the reactant for 1,4-butanediol production, through preparation of maleic anhydride (as shown in Figure 2.3). Moreover, degradable plastics can be derived via biotechnological process, by putting essential genes from micro-organisms in polymer synthesis into targeted plant, enabling these plants to produce plastics through photosynthesis and to accumulate them in various parts of the plants. An example of this type of plastics is polyhydroxyalkanoates (PHAs).

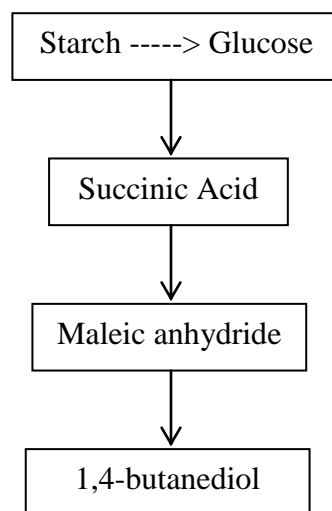


Figure 2.3 Reactant monomer preparation from fermentation process

PBS is non-toxic and it can degrade or decompose into carbon dioxide and water, etc. It is different from the composite of common plastics with starch which is fake biodegradable plastic. It is the true green and environment friendly material. PBS is crystallized biodegradable polyester. Its pellets are white or weak yellow.

PBS has predominant characteristics such as good thermal stability, fine mechanical and processing performance. It can be molding processed in normal plastic fabrication apparatus. Because of its excellent integrated performance, it also can be blended with other fully biodegradable plastic materials to modify the property to satisfy all kinds of manufacturing requirements of plastic products.

Furthermore, PBS has high mechanical performance, good toughness, good thermal stability, wide range of processing temperature and high heat deflection temperature. It can be processed by various molding way with normal equipment. So it has excellent comprehensive properties. To meet the requirements of various products, it can be mixed with other biodegradable or natural materials, such as PLA, PPC, PHAs, PCL and starch or wood powder.

2.2.5 Ethylene Vinyl Acetate [16]

Ethylene vinyl acetate (also known as EVA) is the copolymer of ethylene and vinyl acetate. EVA has a structure as shown in Figure 2.4. The weight percent vinyl acetate usually varies from 10 to 40%, with the remainder being ethylene. It is a polymer that approaches elastomeric materials in softness and flexibility, yet can be processed like other thermoplastics. The material has good clarity and gloss, barrier properties, low-temperature toughness, stress-crack resistance, hot-melt adhesive water proof properties, and resistance to UV radiation. EVA has little or no odor and is competitive with rubber and vinyl products in many electrical applications.

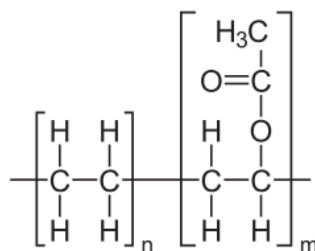


Figure 2.4 Structure of ethylene vinyl acetate

2.2.6 Polymer Blends [17]

The blending of biodegradable polymers is one approach of reducing the overall cost of the material and modifying the desired properties and degradation rates [17-19]. Compared to copolymerization method, blending may be a much easier and faster way to achieve the desired properties. More importantly, through blending, other less expensive polymers could be incorporated with one another. Miscibility of the blends is

one of the most important factors affecting the final polymer properties. Some of the advantages of producing miscible blends are single phase morphology and reproducibility of the mechanical properties. However formation of miscible blends especially with non-biodegradable polymers can slow down or even inhibit the degradation of the biodegradable components.

2.2.7 Polymer Additives [18]

All plastics products are made from the essential polymer mixed with a complex blend of materials known collectively as additives. Without additives, plastics would not work, but with them they can be made safer, cleaner, tougher and more colorful. Additives cost money, of course, but by reducing production costs and making products last longer, they help us to save money and conserve the world's precious raw material reserves. In fact, our world today would be a lot less safe, a lot more expensive and a great deal duller without the additives that turn basic polymers in to useful plastics.

2.2.7.1 Compatibilizers

Most polymer blends are immiscible and need to be compatibilized. The compatibilization must accomplish: (i) optimization of the interfacial tension; (ii) stabilize the morphology against high stresses during forming; and (iii) enhance adhesion between the phases in the solid state. Compatibilization is accomplished either by addition of a compatibilizer or by reactive processing.

2.2.7.2 Antioxidants

Help prevent oxidation reaction, the polymer reacting with oxygen. Oxidation can cause loss of impact strength, elongation, surface cracks and discoloration. Antioxidants help prevent thermal oxidation reactions when plastics are processed at high temperatures and light-assisted oxidation when plastics are exposed to UV light.

Numerous oxidation products are formed as the result of the degradation of polymers, such as peroxides, alcohols, ketones, aldehydes, acids, peracids, peresters, and γ -lactones. Elevated temperatures, irradiation, and catalysts such as metals and metal ions increase oxidation rates. Most polymers have structural elements that are particularly prone to oxidative degradation reactions.

Thermoplastic polymers are prepared by chain polymerization, polyaddition, or polycondensation reactions. Their subsequent processing, usually in several steps, results in commercial end products. During processing, the polymer is subjected to heat and mechanical shear. However, oxygen, heat, light, and water are causes throughout the whole life cycle of the plastic products. Under these conditions, polymer chains undergo cleaving by oxidation, chain branching, and/or crosslinking.

2.2.7.3 Plasticizers

Plasticizers or dispersants are additives that increase the plasticity or fluidity of a material. The dominant applications are for plastics, especially polyvinyl chloride (PVC). The properties of other materials are also improved when blended with plasticizers including concrete, clays, and related products.

Plasticizers for plastics are additives, most commonly phthalate esters in PVC applications. Almost 90% of the market for plasticizer is for PVC, giving this material improved flexibility and durability. The majority is used in films and cables. It was commonly thought that plasticizers work by embedding themselves between the chains of polymers, spacing them apart (increasing the free volume), and thus significantly lowering the glass transition temperature for the plastic and making it softer, however it was later shown that the free volume explanation could not account for all of the effects of plasticization. For plastics such as PVC, the more plasticizer added, the lower its cold flex temperature will be. This means that it will be more flexible and its durability will increase as a result of it.

Plasticizers make it possible to achieve improved compound processing characteristics, while also providing flexibility in the end-use product. Ester plasticizers are selected based upon cost-performance evaluation. The rubber compounder must evaluate ester plasticizers for compatibility, processibility, permanence and other performance properties. The wide variety of ester chemistries that are in production include sebacates, adipates, terephthalates, dibenzoates, glutarates, phthalates, azelates, and other specialty blends. This broad product line provides an array of performance benefits required for the many elastomer applications such as tubing and hose products, flooring, wall-coverings, seals and gaskets, belts, wire and cable, and print rolls. Low to high polarity esters provide utility in a wide range of elastomers including nitrile, polychloroprene, chlorinated polyethylene, and epichlorohydrin. Plasticizer-elastomer interaction is governed by many factors such as solubility parameter, molecular weight, and chemical structure. Compatibility and performance attributes are key factors in developing a rubber formulation for a particular application. Plasticizers also function as softeners, extenders, and lubricants, and play a significant role in rubber manufacturing.

2.2.8 Radiation Chemistry of Polymer [19]

Irradiation of polymers and plastics with high energy radiation (gamma rays, X-rays, electron beams, ion beams) leads to the formation of very reactive intermediates in the forms of excited states, ions and free radicals. These intermediates are almost instantaneously used up in several reaction pathways which result in the arrangement or formation of new bonds structures. The ultimate effects of these reactions are the formation of oxidized products, grafts, crosslinking and scissioning of main or side

chains which is also called degradation. The degree or dominance of these transformations depend on the nature of the polymer and the conditions of treatment before, during, and after irradiation and close control of these factors make the modification of polymers possible by radiation processing.

Radiation induced processes have many advantages over other conventional methods. In radiation processing of polymers no catalysts or additives are required to initiate the reaction. Absorption of radiation energy by the backbone polymer initiates generally a free radical process. With chemical initiation free radicals are produced by the decomposition of an initiator into small fragments which attack the base polymer leading to free radicals. The efficiency of these two processes have been compared and estimated that the same number of initiating radicals are produced in unit time with a radiation dose rate of 1 rad/s or a chemical initiator, such as benzoyl peroxide, at a concentration of 0.1 M is used. The concentration and purity of chemical initiators are additional limiting factors, in the case of radiation processing however the dose rate can be varied easily which makes the control of reaction more easily and better. Chemical initiation has often been associated with problems arising from local overheating of the initiator. The radiation processing is temperature independent, which is therefore considered as a zero activation energy process for initiation.

The polymer, plastics and rubber industries have been the beneficiaries of the unique properties and advantages of ionizing radiation for several decades and there are already a number of very well established large scale applications of radiation processing in these industries. An excellent review has been recently published by Clough evaluating the commercial processes and new applications in this field.

Radiation crosslinking is an established technology in wire and cable industry, where crosslinking of insulators and sheaths imparts resistance to solvents, ageing and high temperatures. Radiation crosslinked tubings are used as hot water pipes. The production of heat-shrinkable packaging films, tubings and other more sophisticated devices and foams have been another well established, interesting application of radiation processing. Radiation pre-crosslinked rubber strips are used in the manufacturing of automobile tyres.

Radiation curing is commercially used on a large scale in surface finishing of coatings, lacquers and inks. For very large production units and if the formulations are opaque, heavily loaded with pigments or magnetic particles, radiation curing is of advantage.

Radiation degradation which is the opposite of crosslinking has found its greatest application in the irradiation of Teflon, which reduces the molecular weight and particle size hence allowing its use as filler for various applications.

Radiation-induced grafting is another powerful method for the modification of existing properties of a polymer and for creating of an almost unlimited range of new materials. At present only very limited commercial applications of grafting is being explored,

production of battery separators from acrylic acid grafted polyethylene being the most important example.

2.2.9 Processing of Polymers [20]

One of the most outstanding features of plastics is the ease with which they can be processed. In some cases semi-finished articles such as sheets or rods are produced and subsequently fabricated into shape using conventional methods such as welding or machining. In the majority of cases, however, the finished article, which may be quite complex in shape, is produced in a single operation. The processing stages of heating, shaping and cooling may be continuous (e.g. production of pipe by extrusion) or a repeated cycle of events (e.g. production of a telephone housing by injection molding) but in most cases the processes may be automated and so are particularly suitable for mass production. There is a wide range of processing methods which may be used for plastics. In most cases the choice of method is based on the shape of the component and whether it is thermoplastic or thermosetting. It is important therefore that throughout the design process, the designer must have a basic understanding of the range of processing methods for plastics since an ill-conceived shape or design detail may limit the choice of molding methods.

Extrusion – plastics extrusion is a high volume manufacturing process in which raw plastic material is melted and formed into a continuous profile as illustrated in Figure 2.5. Extrusion produces items such as pipe/tubing, weather stripping, fence, deck railing, window frames, plastic films and sheet, thermoplastic coatings, and wire insulation. In this process, raw plastic is fed into a heated extruder cavity or cylinder. Typically, the raw plastic is in bead form and may be mixed with colorants before the extrusion process begins, and in some methods, ultraviolet (UV) inhibitors may be added to the raw plastic beads as well. Once inside the machine, the plastic beads and any accompanying material move through an opening in the extruder cavity towards a screw mechanism. The screw rotates, forcing the plastic material to advance through the cavity.

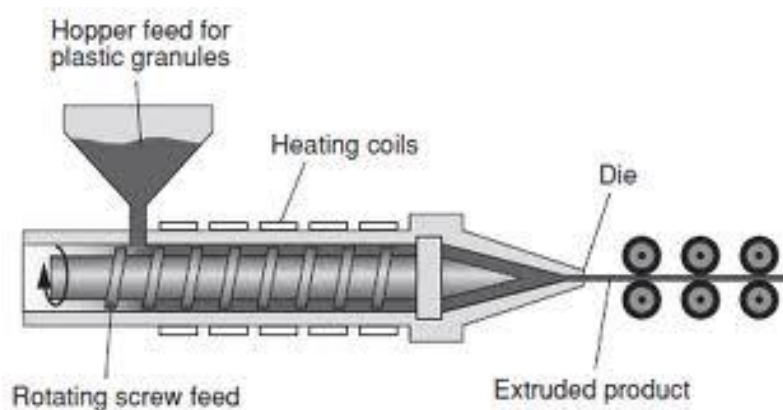


Figure 2.5 Schematic diagram of plastic extruder machine

Inside the cavity, the temperature is very high, often reaching about 400°F (200°C), which melts the plastic. Many extruders involve the use of three different heaters set to gradually increase heat inside the cavity. This reduces the potential for overheating.

Friction and pressure within the cavity serve to produce extra heat that is independent of the heaters. Sometimes, the pressure and friction inside the cavity produces so much heat that the heaters may be shut off. When this happens, the desired temperature is maintained by the friction and pressure. Cooling fans are also employed frequently, helping to keep the machine at the desired temperature. When the molten plastic reaches the front of the barrel, it moves away from the screw and journeys through a special screen designed to filter contaminants out. The molten plastic then moves into a die, which is responsible for giving the molten plastic its profile. The plastic must then be cooled, often by a sealed-water bath; care must be taken to prevent the collapse of the newly formed product in its still molten state. Plastic sheeting and certain other products are cooled by special cooling rolls instead of water baths. After cooling, the product is spooled, coiled, or cut to length. In addition to plastics, a variety of other materials, including aluminum and rubber, may be extruded. Even clay and certain types of foods may be produced this way. The process used may differ from that employed for the purpose of plastic extrusion, however.

Injection Molding – injection molding is a manufacturing process for producing parts from plastic materials as illustrated in Figure 2.6. Material is fed into a heated barrel, mixed, and forced into a mold cavity where it cools and hardens to the configuration of the cavity. After part inside the cavity hardened it is ejected from cavity by ejector pins when the mold is opened.

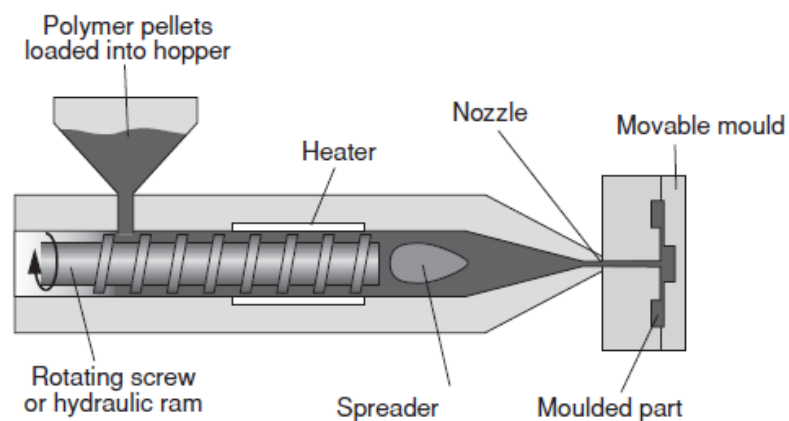


Figure 2.6 Schematic diagram of plastic injection molding machine

Injection molding machines can fasten the molds in either a horizontal or vertical position. The majority of machines are horizontally oriented, but vertical machines are used in some niche applications such as insert molding, allowing the machine to take advantage of gravity. Some vertical machines also don't require the mold to be fastened. There are many ways to fasten the tools to the platens, the most common being manual

clamps (both halves are bolted to the platens); however hydraulic clamps (chocks are used to hold the tool in place) and magnetic clamps are also used. The magnetic and hydraulic clamps are used where fast tool changes are required.

Compression Molding – compression molding is a method of molding in which the molding material, generally preheated, is first placed in an open, heated mold cavity. The mold is closed with a top force or plug member, pressure is applied to force the material into contact with all mold areas, while heat and pressure are maintained until the molding material has cured. The process employs thermosetting resins in a partially cured stage, either in the form of granules, putty-like masses, or preforms. Compression molding is a high-volume, high-pressure method suitable for molding complex, high-strength fiberglass reinforcements. Advanced composite thermoplastics can also be compression molded with unidirectional tapes, woven fabrics, randomly oriented fiber mat or chopped strand. The advantage of compression molding is its ability to mold large, fairly intricate parts. Also, it is one of the lowest cost molding methods compared with other methods such as transfer molding and injection molding; moreover, it wastes relatively little material, giving it an advantage when working with expensive compounds. However, compression molding often provides poor product consistency and difficulty in controlling flashing, and it is not suitable for some types of parts. Fewer knit lines are produced and a smaller amount of fiber-length degradation is noticeable when compared to injection molding. Compression-molding is also suitable for ultra-large basic shape production in sizes beyond the capacity of extrusion techniques. Materials that are typically manufactured through compression molding include: polyester fiberglass resin systems and poly (p-phenylene sulfide) (PPS).

2.2.10 Mechanical Properties Analysis [21]

The bulk properties of a polymer are those most often of end-use interest. These are the properties that dictate how the polymer actually behaves on a macroscopic scale.

The tensile strength of a material quantifies how much stress the material will endure before suffering permanent deformation. This is very important in applications that rely upon a polymer's physical strength or durability. For example, a rubber band with a higher tensile strength will hold a greater weight before snapping. In general, tensile strength increases with polymer chain length and crosslinking of polymer chains.

Young's modulus quantifies the elasticity of the polymer. It is defined, for small strains, as the ratio of rate of change of stress to strain. Like tensile strength, this is highly relevant in polymer applications involving the physical properties of polymers, such as rubber bands. The modulus is strongly dependent on temperature. Viscoelasticity describes a complex time-dependent elastic response, which will exhibit hysteresis in the stress-strain curve when the load is removed. Dynamic mechanical analysis or DMA

measures this complex modulus by oscillating the load and measuring the resulting strain as a function of time.

2.2.11 Thermal Properties Analysis [22]

The thermal properties of plastics can be characterized in particular by their service temperatures and their thermal dimensional stability, and by the glass transition temperature. Thermal analyses of the samples were carried out by using the techniques of Thermogravimetric analysis (TGA) and Differential Scanning Calorimetry (DSC) to identify the samples and types of plastic used for the samples.

Thermogravimetric analysis or thermal gravimetric analysis is a type of testing performed on samples that determines changes in weight in relation to a temperature program in a controlled atmosphere. Such analysis relies on a high degree of precision in three measurements: weight, temperature, and temperature change. To determine composition and purity one must take the mass of the substance in the mixture by using thermal gravimetric analysis. Thermal gravimetric analysis is the act of heating a mixture to a high enough temperature so that one of the components decomposes into a gas, which dissociates into the air. It is a process that utilizes heat and stoichiometry ratios to determine the percent by mass ratio of a solute. If the compounds in the mixture that remain are known, then the percentage by mass can be determined by taking the weight of what is left in the mixture and dividing it by the initial mass. Knowing the mass of the original mixture and the total mass of impurities liberating upon heating, the stoichiometric ratio can be used to calculate the percent mass of the substance in a sample. TGA is commonly employed in research and testing to determine characteristics of materials such as polymers, to determine degradation temperatures, absorbed moisture content of materials, the level of inorganic and organic components in materials, decomposition points of explosives, and solvent residues.

Differential Scanning Calorimetry is a standard tool for measuring the melting and freezing points of polymers and other solids. One way to describe how a DSC works is to think about what happens when you heat a solid with a constant heat input. Initially, the solid polymer is heated from room temperature to its melting point. As it melts from a solid to a molten liquid, the temperature is constant. After the phase change is complete, the temperature starts to rise again. Instead of having a constant heat input, the DSC is based on the temperature increasing at a constant rising rate. This means more or less heat energy is put into the sample to make the temperature increase at a constant rate. When phase change occurs, much higher than normal levels of heat are needed. The point of the maximum heat input is called the melting point. DSC is a thermo-analytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature. Both the sample and reference are maintained at nearly the same temperature throughout the experiment. Generally, the temperature program for a DSC analysis is designed such that the sample holder temperature increases linearly as a

function of time. The reference sample should have a well-defined heat capacity over the range of temperatures to be scanned.

DSC analysis can be used to measure a number of characteristic properties of a sample. Using this technique it is possible to observe fusion and crystallization events as well as glass transition temperatures (T_g). DSC can also be used to study oxidation, as well as other chemical reactions. Glass transitions may occur as the temperature of an amorphous solid is increased. These transitions appear as a step in the baseline of the recorded DSC signal. This is due to the sample undergoing a change in heat capacity; no formal phase change occurs. As the temperature increases, an amorphous solid will become less viscous. At some point the molecules may obtain enough freedom of motion to spontaneously arrange themselves into a crystalline form. This is known as the crystallization temperature (T_c). This transition from amorphous solid to crystalline solid is an exothermic process, and results in a peak in the DSC signal. As the temperature increases the sample eventually reaches its melting temperature (T_m). The melting process results in an endothermic peak in the DSC curve. The ability to determine transition temperatures and enthalpies makes DSC a valuable tool in producing phase diagrams for various chemical systems.

2.2.12 Polymer Morphology Analysis [22]

The scanning electron microscope (SEM) uses a focused beam of high-energy electrons to generate a variety of signals at the surface of solid specimens. The signals that derive from electron sample interactions reveal information about the sample including external morphology (texture), chemical composition, and crystalline structure and orientation of materials making up the sample. In most applications, data are collected over a selected area of the surface of the sample, and a 2-dimensional image is generated that displays spatial variations in these properties. Areas ranging from approximately 1 cm to 5 microns in width can be imaged in a scanning mode using conventional SEM techniques (magnification ranging from 20X to approximately 30,000X, spatial resolution of 50 to 100 nm). The SEM is also capable of performing analyses of selected point locations on the sample; this approach is especially useful in qualitatively or semi-quantitatively determining chemical compositions, crystalline structure, and crystal orientations.

2.2.13 Composition Analysis via FTIR [22]

Fourier transform infrared (FTIR) spectroscopy is a measurement technique that allows one to record infrared spectra. Infrared light is guided through an interferometer and then through the sample (or vice versa). A moving mirror inside the apparatus alters the distribution of infrared light that passes through the interferometer. The signal directly recorded, called an interferogram, represents light output as a function of mirror position. A data-processing technique called Fourier transform turns this raw data into the desired result (the sample's spectrum): light output as a function of infrared wavelength (or equivalently, wavenumber). As described above, the sample's spectrum is always compared to a reference. IR spectroscopy is often used to identify structures because functional groups give rise to characteristic bands both in terms of intensity and position (frequency). The positions of these bands are summarized in correlation tables as shown in Figure 2.7 below.

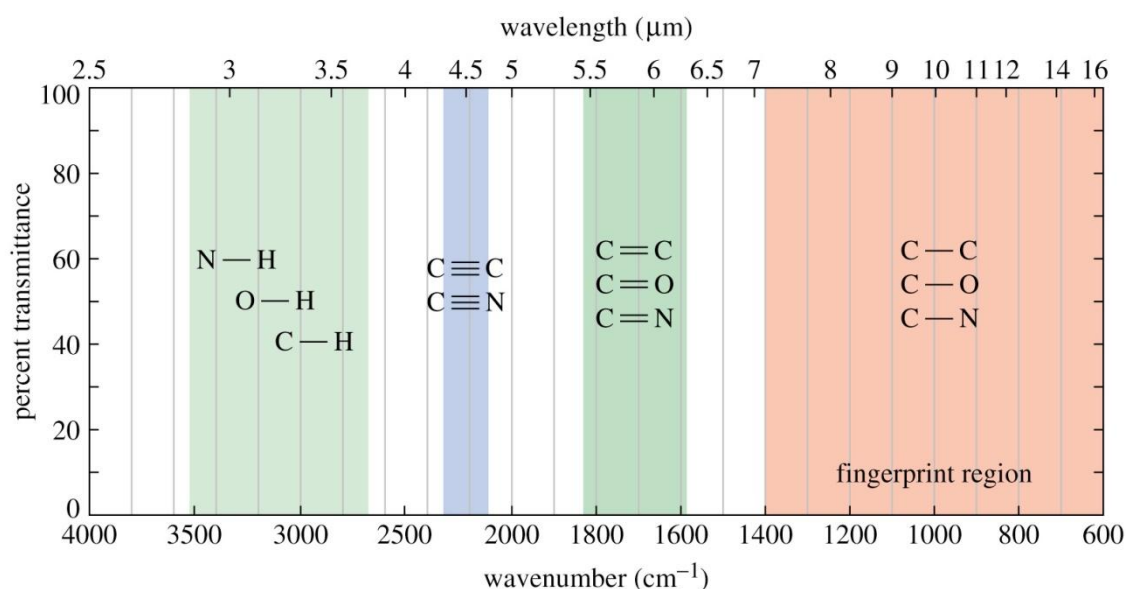


Figure 2.7 Infrared spectroscopy correlation chart

CHAPTER 3 METHODOLOGY

3.1 Chemicals

1. Polybutylene succinate, PBS (BioPBS FZ71PD)
2. Ethylene vinyl acetate, EVA (EscoreneUltra UL04533EH2)
3. Triacetin (Glyceryl triacetate)

3.2 Equipment

1. Twin screw extruder

The machine used was a twin screw extruder provided by P-Prof, the School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Figure 3.1 shows the Thermo Scientific EuroLab 16 XL Twin-Screw Extruder.



Figure 3.1 Twin screw extruder at P-Prof, KMUTT

2. Injection molding machine

The machine used was an injection molding machine provided by Department of Chemistry, Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand. Figure 3.2 shows the Cosmo plastic injection molding machine.



Figure 3.2 Injection molding machine at KMITL

3. Plastic Pelletizer

The machine used was a plastic pelletizer provided by P-Prof, the School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Figure 3.3 shows the plastic pelletizer RP 25C1 by Thai Hydraulic Machinery Co., Ltd.



Figure 3.3 Plastic pelletizer at P-Prof, KMUTT

4. High speed mixer

The machine used was a high speed mixer provided by P-Prof, the School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Figure 3.4 shows the high speed mixer LMXS Lab Tech Engineering.



Figure 3.4 High speed mixer at P-Prof, KMUTT

5. Universal testing machine

The machine used was the universal testing machine provided by the School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Figure 3.5 shows the Universal Testing Machine from Lloyd instruments.



Figure 3.5 Universal testing machine at KMUTT

6. Differential Scanning Calorimeter (DSC)

The machine used was a Differential Scanning Calorimeter provided by the School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Figure 3.6 shows the Differential Scanning Calorimeter DSC 204 Netzsch.



Figure 3.6 Differential Scanning Calorimeter at KMUTT

7. Scanning Electron Microscope (SEM)

The machine used was a Scanning Electron Microscope provided by the School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Figure 3.7 shows the Nova NanoSEM 450.



Figure 3.7 Scanning Electron Microscope at KMUTT

8. Fourier Transform Infrared Spectroscopy (FTIR)

The machine used was a Fourier Transform Infrared Spectroscopy provided by the School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Figure 3.8 shows the Thermo Scientific Nicolet iS5 FT-IR Spectrometer.



Figure 3.8 Fourier Transform Infrared Spectroscopy at KMUTT

9. Linear Accelerator X-ray (LINAC)

The machine used was a Linear Accelerator X-ray (6 MV photon beams) provided by the Division of Radiation and Oncology, Department of Radiology, Faculty of Medicine, Ramathibodi hospital, Mahidol University, Bangkok, Thailand. Figure 3.9 shows the Linear Accelerator X-ray.



Figure 3.9 Linear Accelerator X-ray at Ramathibodi hospital

10. Controlled Temperature Oven

The machine used was a controlled temperature oven provided by P-Prof, the School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi, Bangkok, Thailand. Figure 3.10 shows the controlled temperature oven GT-7017-L by Gotech Testing Machine Company.



Figure 3.10 Controlled temperature oven at P-Prof, KMUTT

3.3 Experiment Procedures

This thesis consists of four main parts; composition analysis of the commercial thermoplastic mask, finding the appropriate ratio of polymer blend, and comparing the prepared masks with the thermoplastic masks for hospital use, studying effect of plasticizer on the polymer blend, and studying effect of irradiation on the polymer blend.

3.3.1 Analysis of the commercial thermoplastic mask

1. The two brands of the commercial thermoplastic masks were analyzed to determine chemical compositions by Fourier Transform Infrared Spectroscopy (FTIR).
2. Thermal properties of commercial thermoplastic masks were measured by using Differential Scanning Calorimeter (DSC).

3.3.2 Finding the appropriate ratio between PBS/EVA

1. The pellets of both PBS and EVA were initially dried in a vacuum oven at a temperature of 60°C for 2 hours to remove water before processing through the extruder.
2. Drying is necessary to minimize the hydrolytic degradation of the polymers during melt processing in the extruder. The extruded strand was cooled in water and pelletised using a pelletizer.
3. Blends of PBS and EVA with various compositions were extruded by melt blending at 110°C. Blends of various compositions were prepared as shown in Figure 3.1.
4. Mechanical properties of specimens are measured by Universal tensile testing machine, the major parameters that measured are the tensile strength, percent elongation and modulus.
5. Thermal properties of specimens are measured by using Differential Scanning Calorimeter (ASTM E794).
6. Morphology of the polymer blends was investigated with high-resolution scanning electron microscopy (SEM), operated at an acceleration voltage of 15 kV. The blends were fractured in liquid nitrogen.
7. Select the appropriate ratio of the polymer blends of PBS/EVA by comparing with the commercial thermoplastic mask sample.

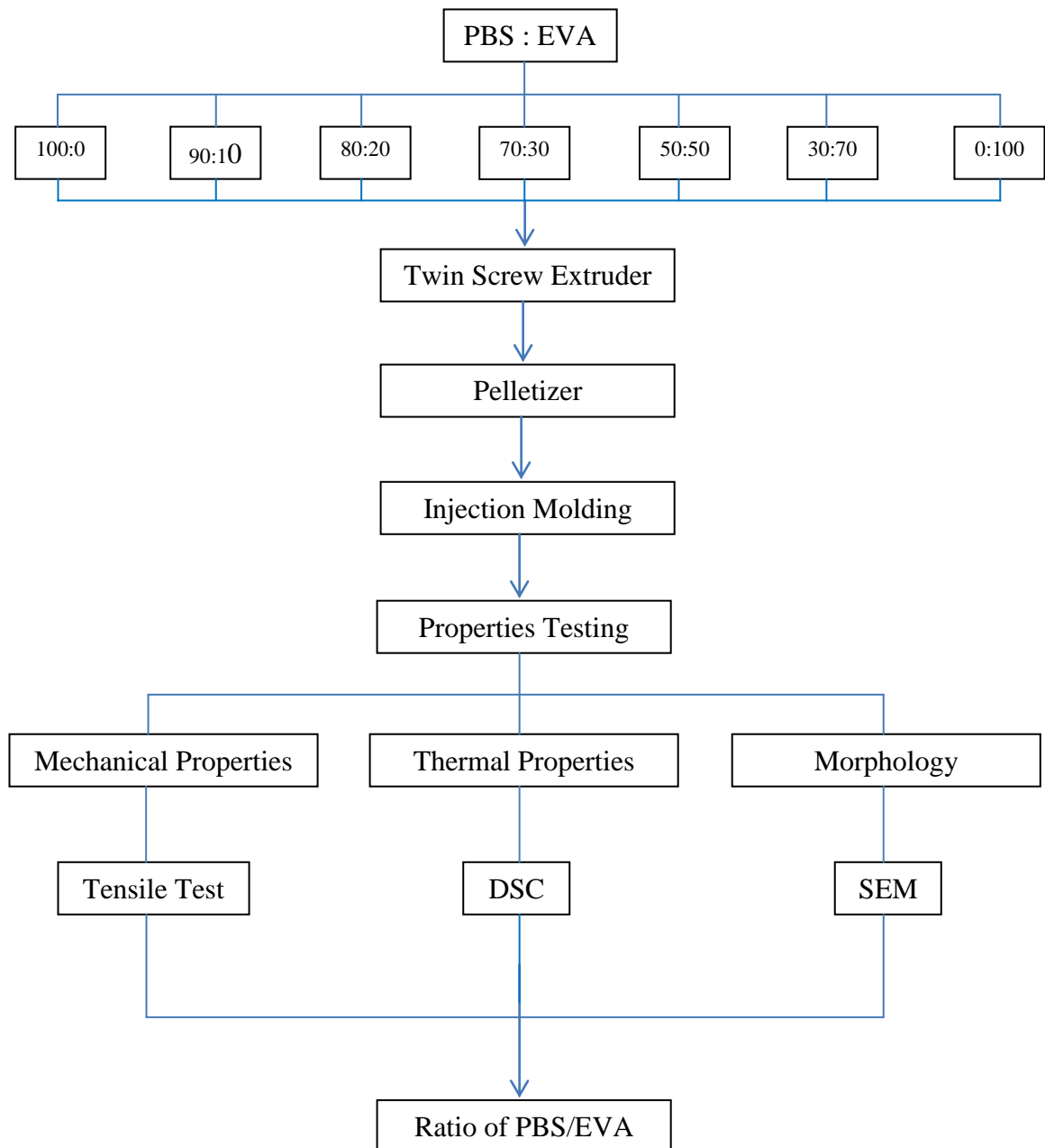


Figure 3.11 Process flowchart of the finding the appropriate ratio of the polymer blends of PBS/EVA

3.3.3 Studying effect of plasticizer on the polymer blend of PBS/EVA

1. The pellets of both PBS and EVA were initially dried in a vacuum oven at a temperature of 60°C for 2 hours to remove water before processing through the extruder.
2. Drying is necessary to minimize the hydrolytic degradation of the polymers during melt processing in the extruder. The extruded strand was cooled in water and pelletized using a pelletizer.
3. Blends of PBS/EVA and triacetin with various compositions were extruded by melt blending at 110°C. Blends of various compositions were prepared as shown in Figure 3.2.
4. Mechanical properties of specimens are measured by Universal tensile tester, the major parameters that measured are the tensile strength, percent elongation and modulus.
5. Thermal properties of specimens are measured by using Differential Scanning Calorimeter (ASTM E794).
6. Morphology of the polymer blends was investigated with high-resolution scanning electron microscopy (SEM), operated at an acceleration voltage of 15 kV. The blends were fractured in liquid nitrogen.
7. Select the appropriate ratio of the PBS/EVA and triacetin.

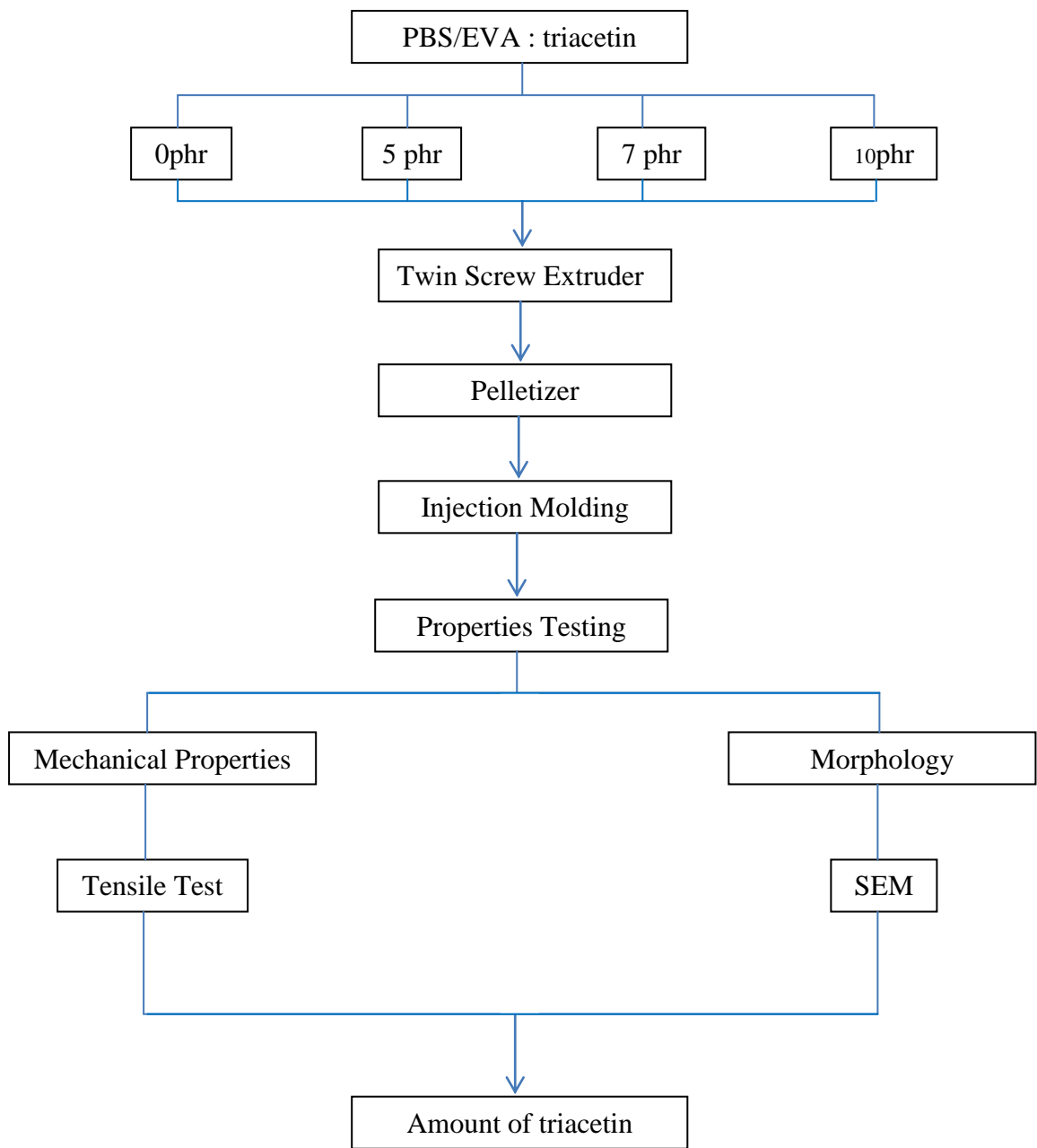


Figure 3.12 Process flowchart of the studying effect of plasticizer (triacetin) on the polymer blend of PBS/EVA

3.3.4 Studying effect of irradiation on the polymer blend of PBS/EVA

1. The appropriate blends of PBS/EVA and triacetin were analyzed by Gamma Radiotherapy Linear Accelerator (6 MV photon beams) for 7,000 cGy intensity of irradiation (as shown in Figure 3.3).
2. Mechanical, chemical properties are measured.

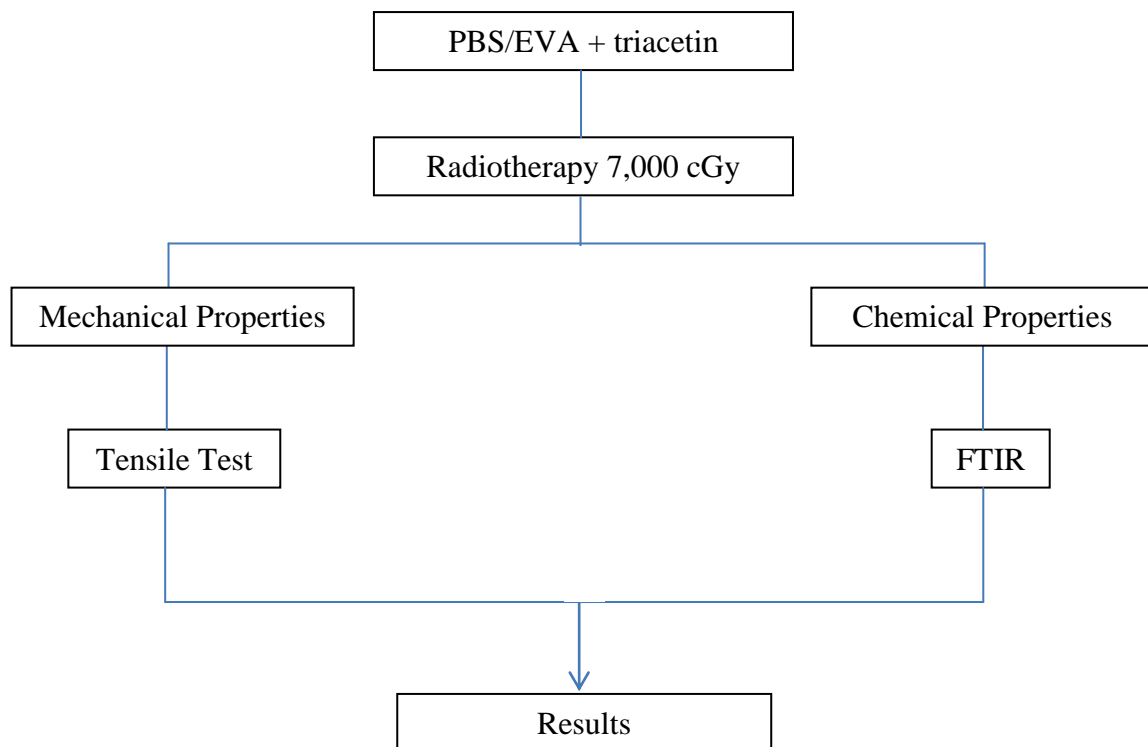


Figure 3.13 Process flowchart of the studying effect of radiotherapy on the polymer blend of PBS/EVA

CHAPTER 4 RESULTS AND DISCUSSION

In this chapter, the experimental results on PBS-EVA blends were discussed. Specifically, effects of mixing ratio of PBS-EVA, plasticizer, and irradiation on mechanical, thermal and morphological properties of blends were focused.

4.1 Analysis of the commercial thermoplastic masks

4.1.1 Composition analysis of the commercial thermoplastic masks via FTIR

Figure 4.1 and 4.2 illustrate the FTIR spectrum of the commercial thermoplastic mask I (CIVCO) and II (KLARITY), respectively. The infrared spectrum is a plot of the percentage of transmittance versus wave number (frequency, cm^{-1}). The infrared spectrum has many peaks (bands), but only a few correlate to structure as shown in Table 4.1.

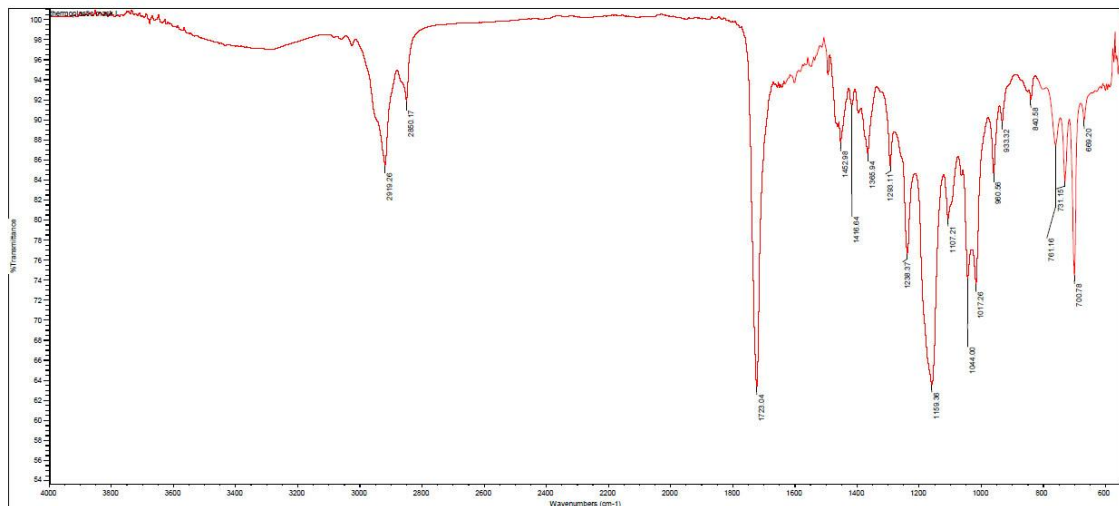


Figure 4.1 FTIR spectrum of the commercial thermoplastic mask I

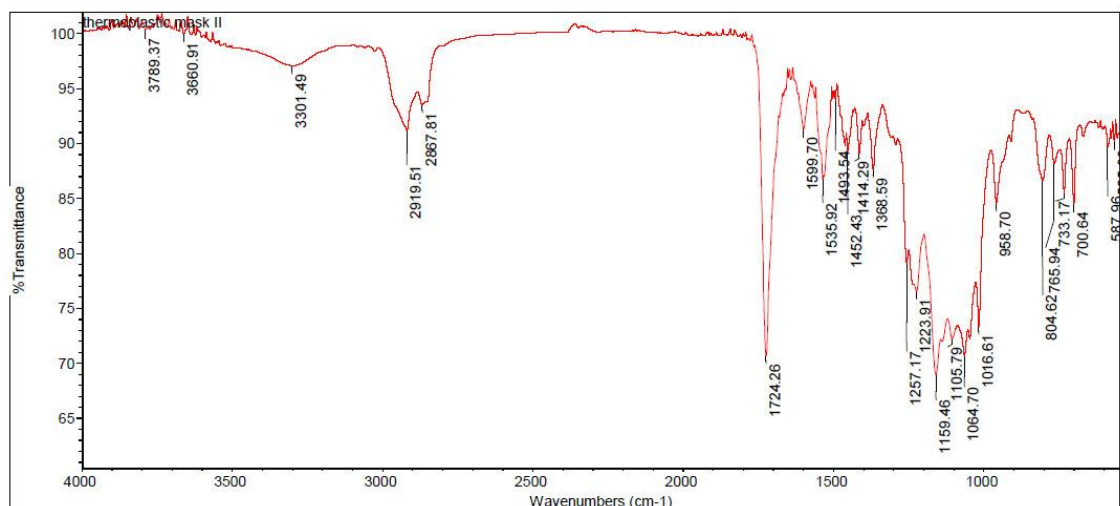


Figure 4.2 FTIR spectrum of the commercial thermoplastic mask II

The resulting spectrum represents the corresponding molecular structure. Asymmetric CH_2 stretching, symmetric CH_2 stretching, C-O, C-C stretching, C-O, C-C stretching, asymmetric C-O stretching, O-C-O stretching and the main peak carbonyl stretching ($\text{C}=\text{O}$) frequency at $1722\text{-}1724\text{ cm}^{-1}$. The wave number $1722\text{-}1724\text{ cm}^{-1}$, which indicated the carbonyl stretching, is the polyester. The asymmetric CH_2 stretching frequency at $2919\text{-}2920\text{ cm}^{-1}$ and the symmetric CH_2 stretching frequency at $2851\text{-}2867\text{ cm}^{-1}$ were indicated that the polymer was possible to be polyethylene. Moreover, the U.S. patent No. 4,483,333 [23] was claimed that an orthopedic cast material was prepared from a mixture of polyethylene and the thermoplastic polyester having a melting point between $50\text{-}100^\circ\text{C}$ and a molecular weight of over 5,000. Polyester and polyethylene were disclosed as the preferred component of the orthopedic cast system.

Table 4.1 FTIR spectroscopy transmittance bands of thermoplastic mask

Wavenumber (cm^{-1})	Possible assignment
2919-2920	Asymmetric CH_2 stretching
2851-2867	Symmetric CH_2 stretching
1722-1724	Carbonyl stretching ($\text{C}=\text{O}$)
1293	C-O, C-C stretching
1240	Asymmetric C-O stretching
1159	O-C-O stretching

4.1.2 Thermal analysis of the commercial thermoplastic masks by DSC technique

As a result of the FTIR spectrum of the commercial thermoplastic masks, it was found that two commercial thermoplastic masks possibly consist of the same polymers. So, only the commercial thermoplastic mask I was analyzed the degradation temperature by Thermogravimetric Analysis (TGA). Decomposition processes proceed in single main stage. The decomposition of commercial thermoplastic mask takes place in the temperature range of 300-480°C.

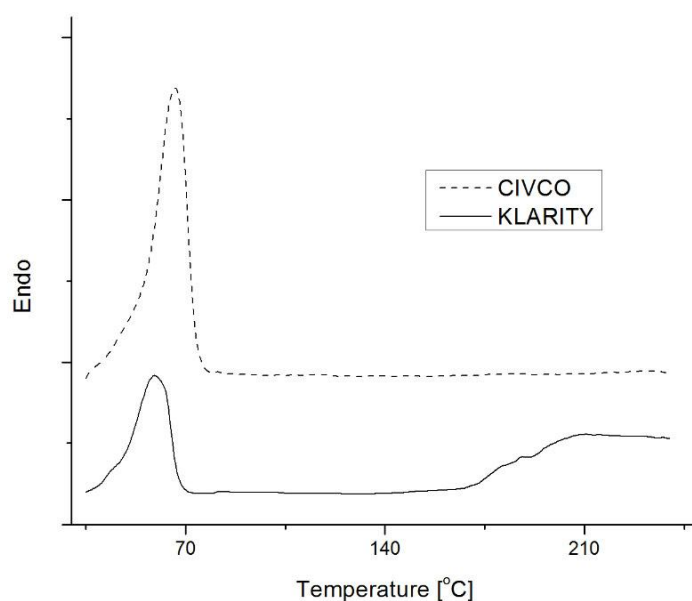


Figure 4.3 DSC thermograms of the commercial thermoplastic masks

Figure 4.3 illustrates the melting temperature of the commercial thermoplastic mask I and II, which have the melting temperature at 69.6°C and 62.5°C, respectively. The melting temperature result was analyzed by DSC technique near the melting temperature of PCL, which is the polyester (melting temperature = 64°C). According to the CIVCO thermoplastics reference guide, the thermoplastic mask was placed into water bath at 70-75°C. [12-13]

4.2 Finding the appropriate ratio between PBS and EVA

The pellets of both PBS and EVA were dried in a vacuum oven at a temperature of 60°C to remove water before processing through the extruder. Blends of PBS and EVA with various compositions were extruded by melt blending at 110°C . Blends of various compositions were prepared as shown in Table 4.2.

Table 4.2 Compositions of PBS-EVA blends

PBS content (% wt.)	100	90	80	70	50	30	0
EVA content (% wt.)	0	10	20	30	50	70	100

All the blends were given the same processing treatment to maintain the overall consistency. Prepared blends were again dried at 60°C in vacuum oven for 2 hours before injection. The molding temperature profiles of the injection molding machine for neat PBS and neat EVA, and PBS-EVA blends were 115°C , 120°C and 125°C , respectively. Molded specimens were then cooled to 50°C before removal from the mold. Dumbbell shaped samples (ASTM D638 Type IV) were compressed for 2 minutes under pressure for mechanical testing (as shown in Figure 4.4).



Figure 4.4 ASTM D638 Type IV specimens of PBS-EVA blends

4.2.1 Tensile Properties

Tensile testing to study tensile strength, Young's modulus, and percentage elongation at break were performed using Universal testing machine at 25°C (room temperature). All tests were done according to ASTM D638 standard. Test for neat PBS and blends were carried out with a crosshead speed of 50 mm/min for neat EVA. Properties values reported here represent an average of the results for tests run on five specimens.

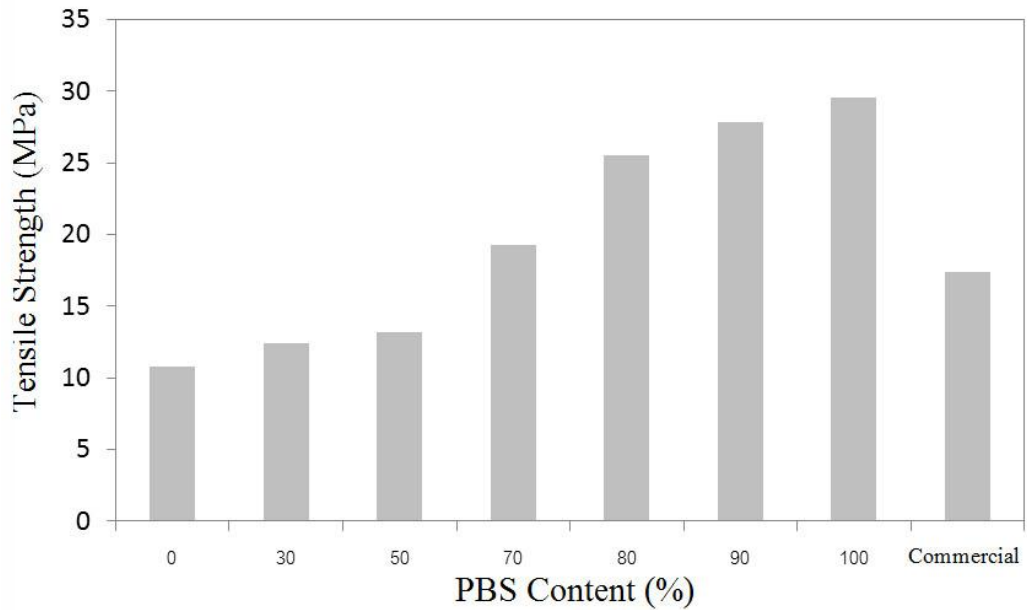


Figure 4.5 Tensile strength of PBS-EVA blends

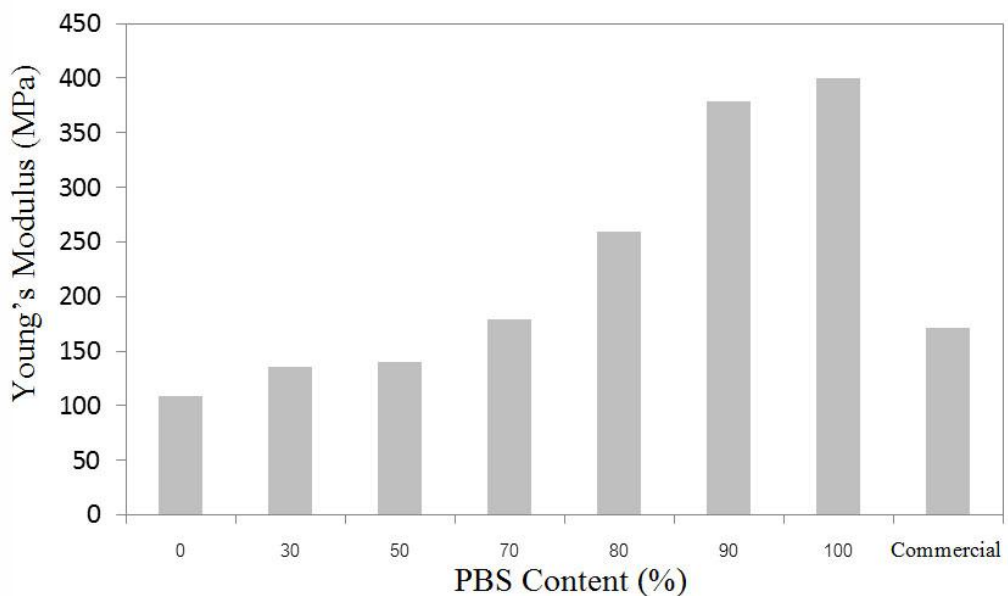


Figure 4.6 Young's modulus of PBS-EVA blends

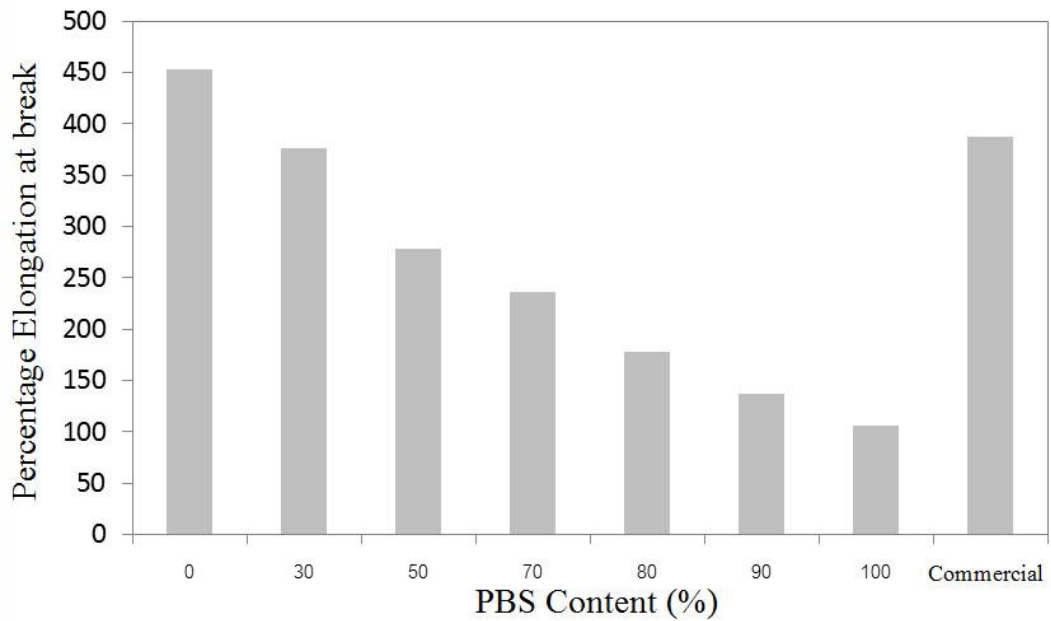


Figure 4.7 Percentage elongation at break of PBS-EVA blends

Figure 4.5 shows tensile strength of various PBS-EVA compositions. It is clear from this figure that tensile strength increased with PBS contents. The same type behavior is seen in Young's modulus as shown in Figure 4.6. And the percentage elongation at break of blends decreased as shown in Figure 4.7. The trend of increasing tensile strength and Young's modulus, due to PBS molecular orientation is more crystalline than EVA. Hence, increasing of PBS contents affected to strength.

From the results of tensile strength and Young's modulus of 50% PBS it may be seen that the 50/50 blend composition incompatibility may be attributed to that during extrusion the solidification of the matrix phase before minor phase may result in bad adhesion between two phases. Bad adhesion between two phases results in lower interfacial tension and hence the lower is the internal stress. A slow decline of both tensile strength and Young's modulus in the 50/50 blend composition is uncompatibilized, and proved that each polymer showed their individual properties.

As the above results it can be concluded that the 70/30 blend composition of PBS in EVA miscibility is possible that it can be used for preparing thermoplastic mask.

4.2.2 Thermal Properties

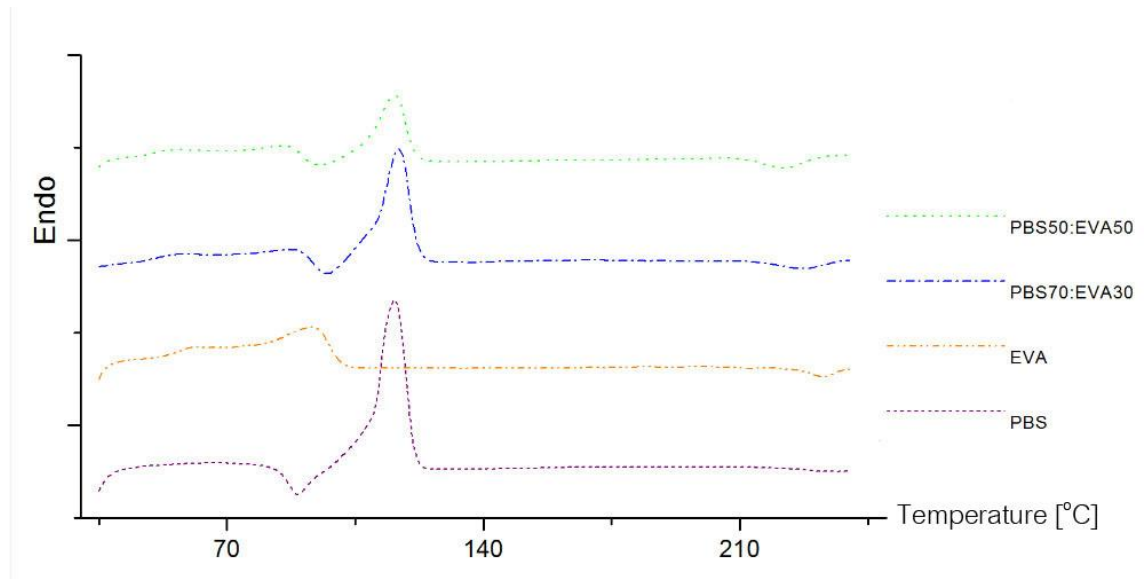


Figure 4.8 DSC thermograms of various PBS-EVA compositions

Figure 4.8 shows DSC thermograms of various PBS-EVA compositions. It was found that the melting temperature increases with PBS contents nearby the melting temperature of neat PBS because the crystalline bulk polymer of PBS contains chains that are arranged more than a well-ordered. Also the percentage of crystallinity of the PBS-EVA blends increases with PBS contents which provided from DSC 204 F1 Netzsch (as shown in Table 4.3). Furthermore, it can be seen that the onset crystallization temperature of EVA is not clear, whereas the onset crystallization temperature of the blends can be seen clearly.

Table 4.3 Results of thermal analysis of PBS-EVA blends via DSC

PBS/EVA	T_m (°C)	$T_{c \text{ (onset)}}$ (°C)	% Crystallinity
0/100	87.1	-	19.64
50/50	115.7	93.6	22.88
70/30	116.2	95.1	27.33
100/0	117.5	91.2	36.40

4.2.1 Morphology test

SEM micrographs from the surface of PBS-EVA blends with different mixing ratio were presented in Figure 4.9. The 70/30 blend composition (b), EVA phases are evenly dispersed in continuous PBS matrix phase. At 70/30 blend composition (b), this blend morphology shows that PBS and EVA are miscible. The 50/50 blend composition is uncompatibilized (c), it was seen that each polymer showed their individual properties. Lack of interaction and difference in solubility parameter between components could lead to thermodynamically immiscible 50/50 PBS-EVA blends.

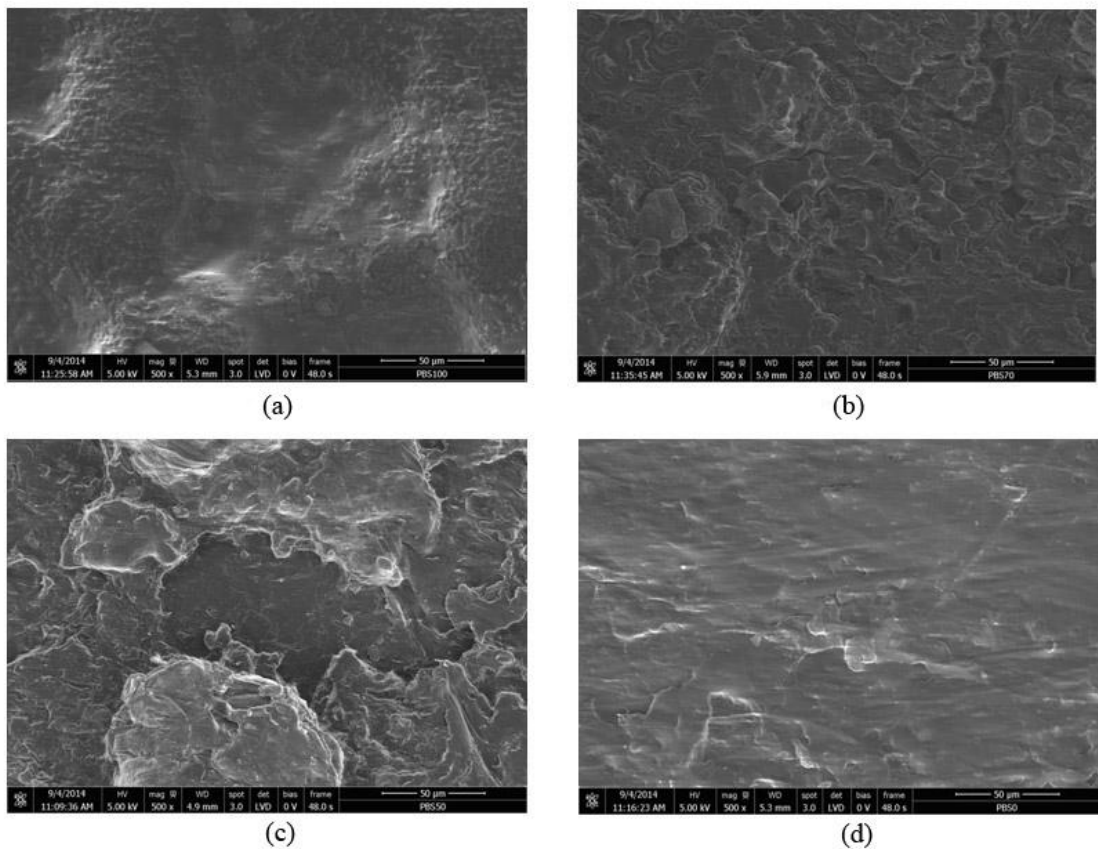


Figure 4.9 Morphology of PBS-EVA blends at various compositions

(a) 100/0 (b) 70/30 (c) 50/50 (d) 0/100

4.3 Effect of addition the plasticizer on the polymer blend of PBS and EVA

All the blends were given the same processing treatment to maintain the overall consistency. Prepared blends were again dried at 60°C in vacuum oven for 2 hours before injection. Triacetin was added as plasticizer to prove the mechanical properties. The molding temperatures for neat PBS, neat EVA and their blends were 115°C , 120°C and 125°C , respectively. Molded specimens were then cooled to 50°C before removal from the mold. Dumbbell shaped samples (ASTM D638 Type IV) were compressed for 2 minutes under pressure for mechanical testing.

4.3.1 Tensile Properties

Tensile testing to study tensile strength, Young's modulus, and percentage elongation at break were performed using Universal testing machine at room temperature. All tests were done according to ASTM D638 standard. Test for all specimen blends were carried out with a crosshead speed of 50 mm/min for neat EVA. Properties values reported here represent an average of the results for tests run on seven specimens.

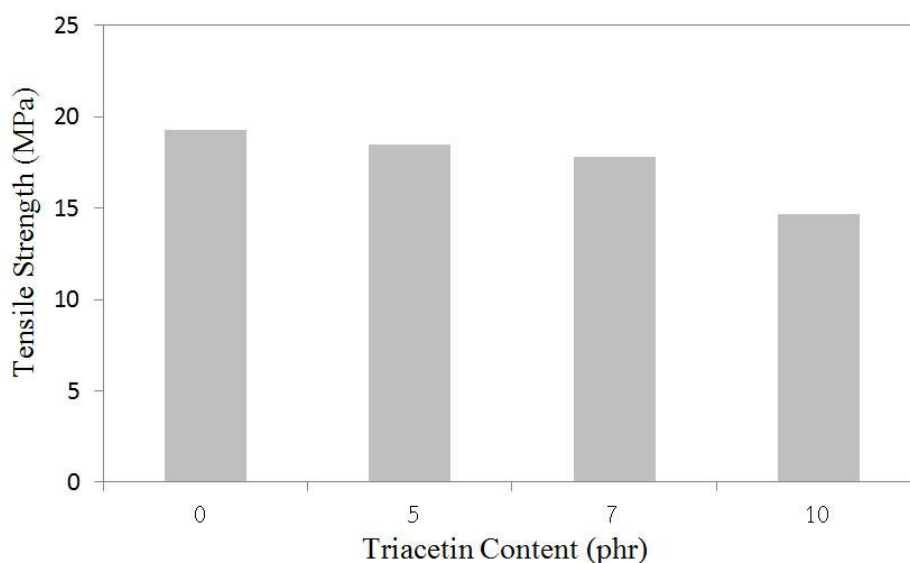


Figure 4.10 Tensile strength of PBS-EVA blends with various content of triacetin

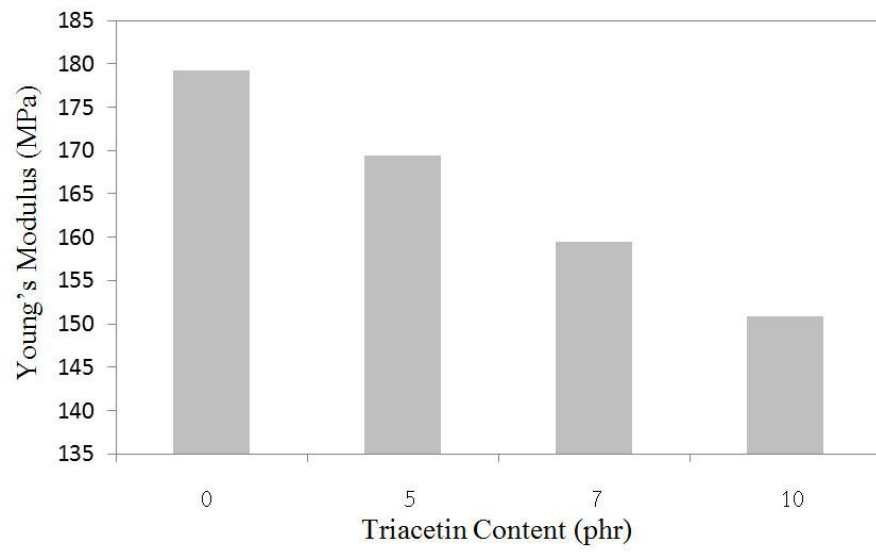


Figure 4.11 Young's modulus of PBS-EVA blends with various content of triacetin

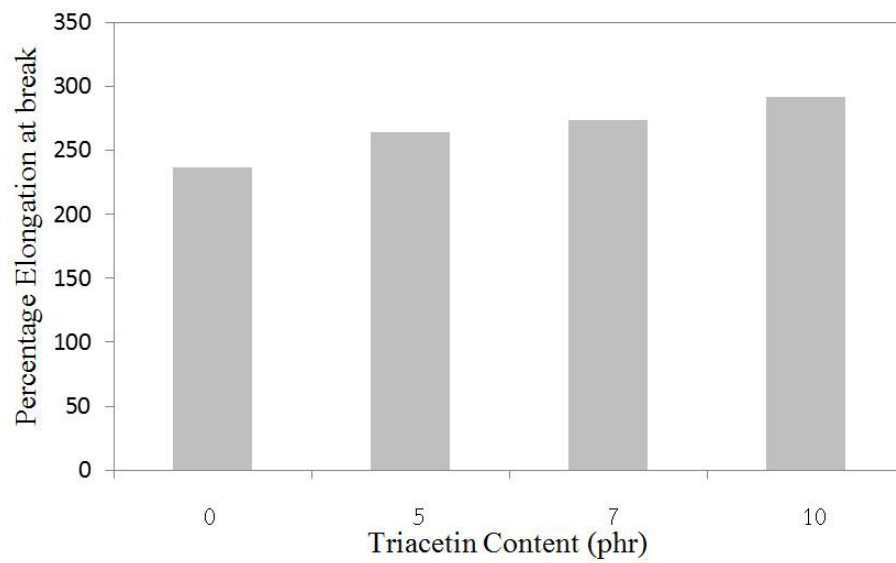


Figure 4.12 Percentage elongation at break of PBS-EVA blends with various content of triacetin

Figure 4.10 shows tensile strength of PBS-EVA blends with various content of triacetin. It is clear from this figure that tensile strength decreased with triacetin contents. The same type behavior is seen in Young's modulus as shown in Figure 4.11. And the percentage elongation at break of blends increased as shown in Figure 4.12. The plasticized PBS specimen is from that of brittle to soft and flexible polymer. The tensile strength decreases as the amount of plasticizer increases. This represents the stress applied at the point where the specimen breaks. Young's modulus also decreases as the amount of plasticizer increases. These results are in agreement with the general finding that plasticizers increase the ductility and flexibility of specimens which is often accompanied by a reduction in tensile strength and modulus of elasticity [24]. The percentage elongation at break of the PBS-EVA systems generally increases with increasing plasticizer compositions. It can therefore be inferred that the 10 phr of triacetin has the best all round properties. The plasticizer reduces the physical intermolecular forces, known as van der Waals forces between the polymer chains [25], thereby increasing chain mobility which results in softening. The degree of polarity requisite in a plasticizer depends to some extent on attractive forces between the polymer chains.

4.3.2 Morphology test

SEM micrographs from the surface of PBS-EVA blends with 10 phr of triacetin were presented in Figure 4.13. Spherical droplets of EVA phases are evenly dispersed in continuous PBS matrix phase. This blend morphology shows that PBS and EVA are immiscible. Plasticizer also has another effect on immiscible blends. It can be seen that the spherical droplet of the minor component (EVA) in an immiscible blend. As the two polymers are immiscible each other, they try to minimize contact. The less surface area the spheres have, the less contact the two phases have. This means the spheres will tend to be relatively large. But the plasticizer lowers the energy of the phase boundary, it means that the two phases can stand each other a little more when there is the plasticizer present. So the need to minimize contact between the two phases isn't as great. So when the plasticizer was used, the spheres don't need to be as big. This is good for the mechanical properties of the immiscible blend [16]. The spherical droplets disperse, the greater matrix of the phase boundary between the two phases, of course. The greater matrix of the phase boundary, the more efficiently energy can be transferred from one phase to the other, meaning better mechanical properties as the percentage elongation at break.

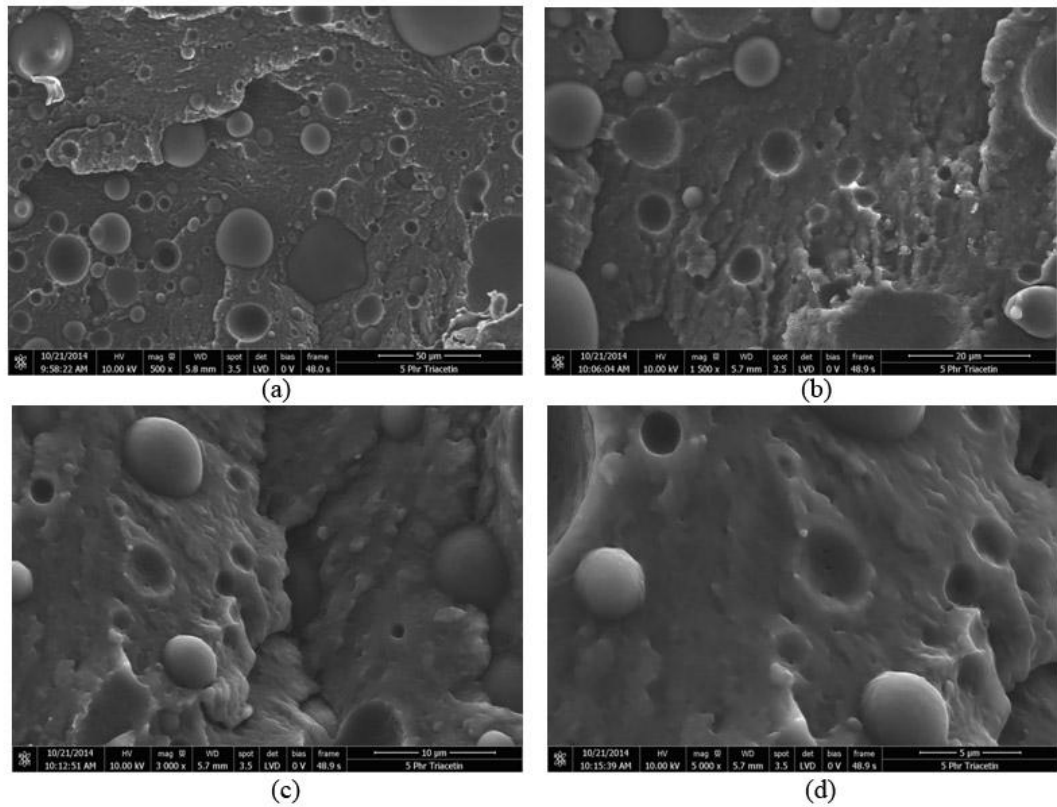


Figure 4.13 Morphology of PBS-EVA blends with 10 phr of triacetin

(a) 500x (b) 1,000x (c) 3,000x (d) 5,000x

4.4 Effect of the irradiation on the polymer blend of PBS and EVA

As previous article, the appropriate blends of PBS/EVA with 10 phr of triacetin were analyzed by Gamma Radiotherapy Linear Accelerator (6 MV photon beams) for 7,000 cGy intensity of irradiation as shown in Figure 4.14.

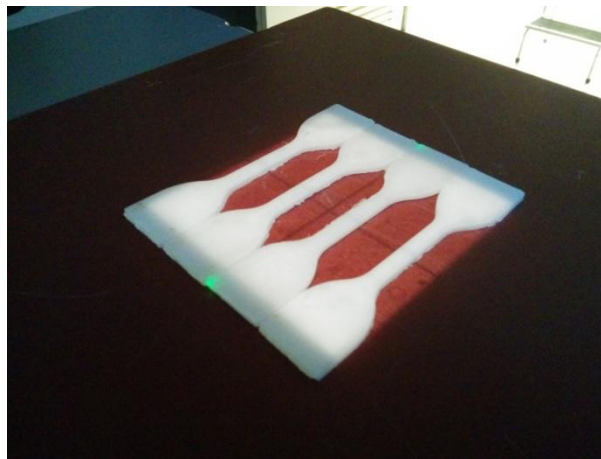


Figure 4.14 Specimens of PBS-EVA blends after irradiation

4.4.1 Tensile Properties

Figure 4.15, 4.16 and 4.17 show the tensile strength of PBS-EVA blends before and after irradiation, Young's modulus of PBS-EVA blends before and after irradiation, and the percentage elongation at break of PBS-EVA blends before and after irradiation, respectively. It can be seen that all tensile properties do not change much with 7,000 cGy intensity of irradiation. According to the "Stability and Stabilization of Polymer under Irradiation Report" (IAEA, 1999) [11] in the literature described that post-irradiation degradation effects in polymeric materials when irradiated samples were subjected to elevated high temperature or held at room temperature for an extended time period. Further, it was discovered that no change of the mechanical and thermal properties, even when the radiation dose is higher than 10 kGy.

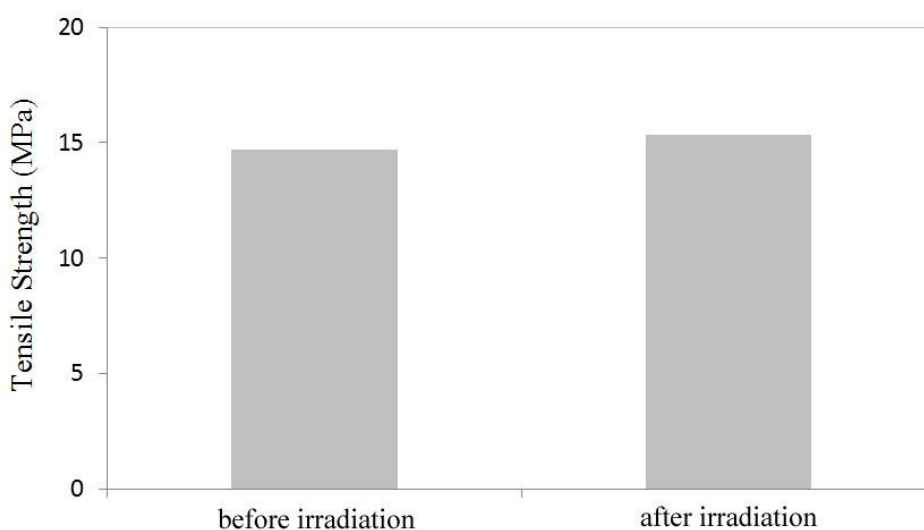


Figure 4.15 Tensile Strength of PBS-EVA blends before and after irradiation

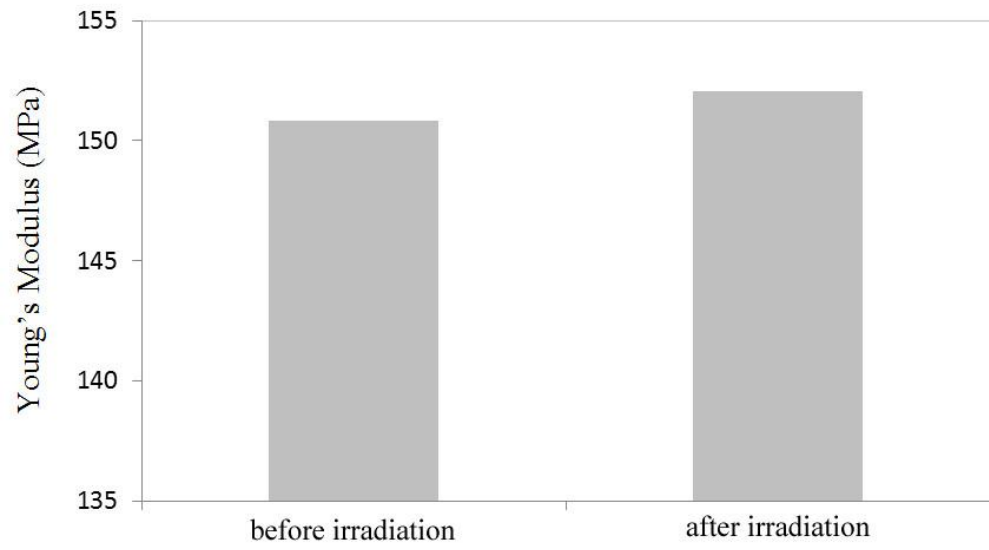


Figure 4.16 Young's modulus of PBS-EVA blends before and after irradiation

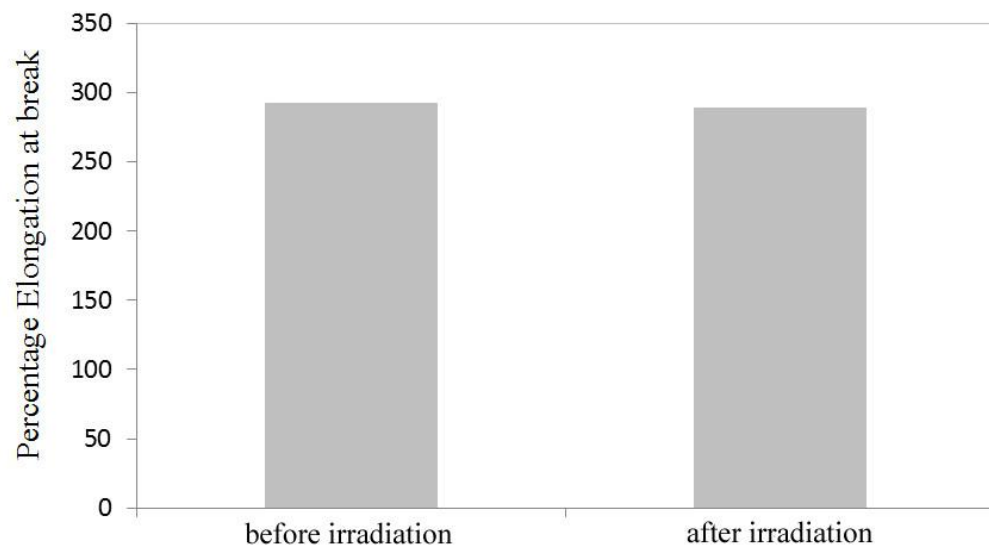


Figure 4.17 Percentage elongation at break of PBS-EVA before and after irradiation

4.4.2 Composition analysis of the polymer blend after irradiation via FTIR

Figure 4.18 and 4.19 illustrate the FTIR spectrum of PBS-EVA with 10 phr of triacetin before irradiation and after irradiation, respectively. There are two main peaks of O-C-O stretching and C=O stretching at 1153.40 and 1712.57 cm^{-1} , respectively. According to the spectrum band, it can be indicated that C=O stretching, is polybutylene succinate and O-C-O stretching is ethylene vinyl acetate. It was found that the chemical composition do not change with 7,000 cGy intensity of irradiation as the same results of previous article 4.4.1.

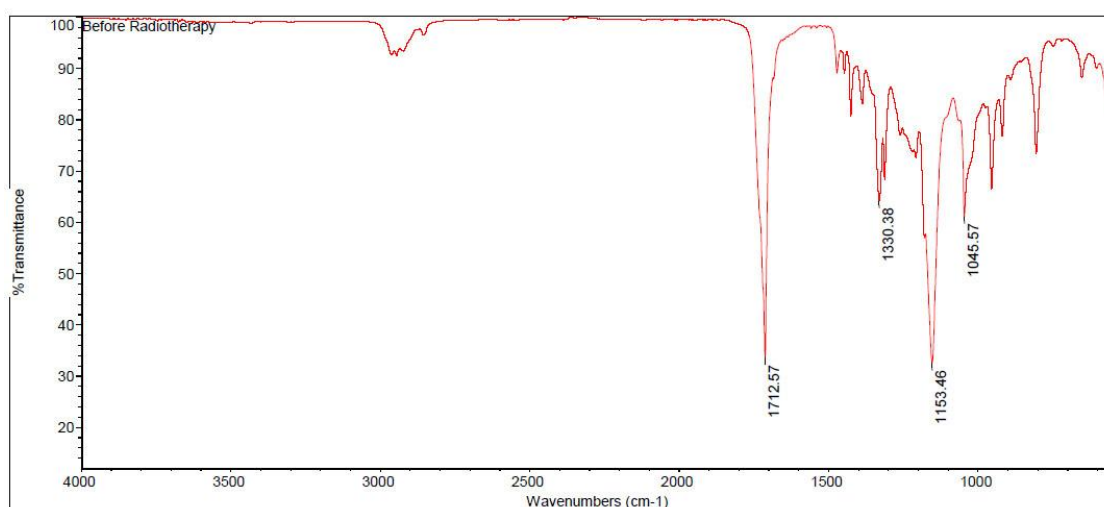


Figure 4.18 FTIR spectrum of PBS-EVA blend before irradiation

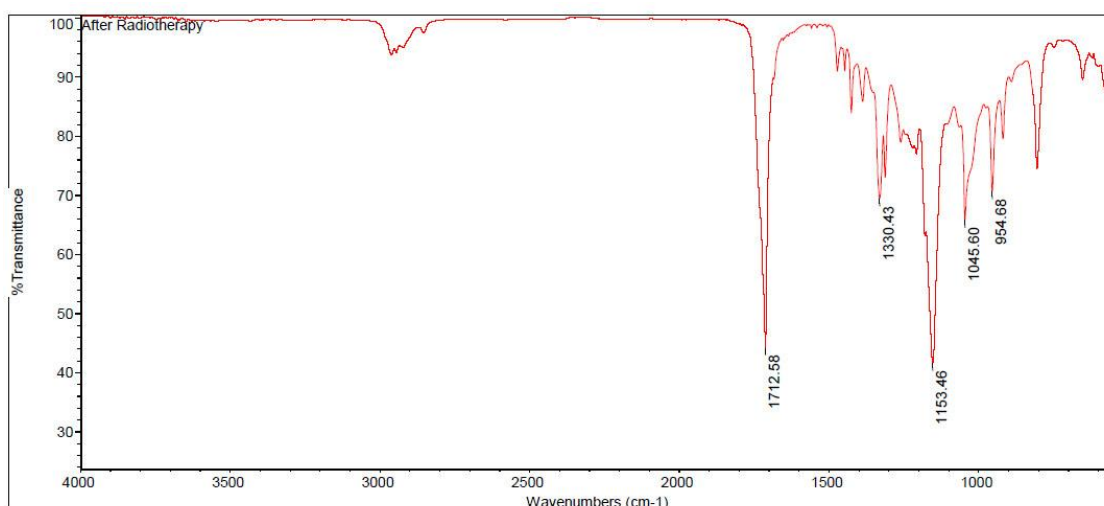


Figure 4.19 FTIR spectrum of PBS-EVA blend after irradiation

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In this work, the polymer blends of polybutylene succinate (PBS) and ethylene vinyl acetate (EVA) were used to prepare thermoplastic masks for radiotherapy. Mechanical and thermal properties of polymer blend specimens were compared with the thermoplastic masks for hospital use. It can therefore be inferred the results as follows;

1. The commercial thermoplastic mask used in the hospital was prepared from two main polymers those are the polyester and polyethylene by Fourier Transform Infrared Spectroscopy (FTIR) technique and Differential Scanning Calorimeter (DSC) technique analysis.
2. The 70/30 blend composition of PBS-EVA is the appropriate ratio for preparing the thermoplastic mask.
3. Addition of triacetin as a plasticizer on the PBS-EVA blend can reduce the tensile strength and Young's modulus, while increase the percentage elongation at break. As a results that the physical intermolecular forces between the polymer chains were decreased, thereby increasing chain mobility which results in the softening of the polymer.
4. Irradiation of 7,000 cGy intensity has no effect on the mechanical and chemical properties because the degradation effect on the polymeric material can be occurred when the radiation dose is higher than 10 kGy.

5.2 Recommendations

1. The prepared PBS-EVA blend specimen should be molded in plastic net sheet form similar to the commercial thermoplastic mask for hospital used.
2. More than two polymer blends should be studied to improve the mechanical and thermal properties for the best results.
3. Polymer additives should be added to improve the thermal properties for lowering the melting temperature (about 60°C) and improve the compatibility of immiscible polymers by adding the compatibilizer.

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28. **Triacetin**, Food Grade, Eastman Catalog.
29. **KLARITY Thermoplastic Masks**, Radiation Therapy Product Catalog.

APPENDIX A

Chemical Characterization

Polybutylene Succinate [26]

BioPBS FZ71PD

Product Description

BioPBS is bio-based polybutylene succinate (PBS) produced from polymerization of bio-based succinic acid and 1,4-butanediol. Alike LDPE, BioPBS is soft and flexible semi-crystalline polyester with excellent properties suitable for extrusion lamination blown film extrusion, casting, and injection molding.

Table A1 PBS Properties

Properties	Test Method	Unit	FZ71PD
Density	ISO 1183	g/cm ³	1.26
MFR (190°C, 2.16 kg)	ISO 1183	g/10min	22
Melting Point	ISO 3146	°C	115
Yield Stress	ISO 527-2	MPa	40
Stress at Break	ISO 527-2	MPa	30
Strain at Break	ISO 527-2	%	120
Flexural Modulus	ISO 178	MPa	630
Flexural Strength	ISO 178	MPa	40
Izod Impact Strength (23°C)	ISO 180	kJ/m ²	7
Heat Deflection Temperature (0.45 MPa)	ISO 75-1	°C	90
Rockwell Hardness	ISO 2039-2	R Scale	103

Process Information

BioPBS is dried and packed in aluminum-lined packaging before delivering to customers. Pre-dry of the unopened BioPBS is not necessary. We recommended keeping packages sealed until ready to process and using up the whole 25 kg bag. Unused material should be tightly sealed, kept away from open air, and pre-dried to moisture content of less than 700 ppm prior to using next time.

Table A2 PBS Processing Parameters

Recommended Processing Parameters	
Melt Temperature (°C)	250-260
Feed Throat (°C)	120
Barrel Temperature (°C)	220-260
Adapter Temperature (°C)	250-260
Die Temperature (°C)	245-260
Chill Roll Temperature (°C)	15

Compostability

BioPBS FZ71PD meets the requirements of European standard EN13432, USA standard ASTM D6400, and GreenPla mark in Japan to be compostable into carbon dioxide, water, and minerals that do not adversely affect the quality of compost. Additionally, FZ71PD is naturally compostable at 30°C, with the existence of moisture and bacteria, into water. Consumers can enjoy their favorite food and drink, and then throw away BioPBS paper into regular trash bin and left the nature works on compostable. PBS film of 200 µm can be biodegradable within 1 year at 30°C and 50% RH in soil.

Notice to Customer

Information in this document is based on our current knowledge and experience. It does not relieve customer of the responsibility to carry out their own tests and experiments nor do they imply any legally binding assurance. Customers are responsible to determine their freedom-to-operate to ensure that their products do not infringe any intellectual properties.

Ethylene Vinyl Acetate [27]

Escorene™ Ultra UL04533EH2

Product Description

UL04533EH2 is a copolymer of ethylene and vinyl acetate.

Table A3 EVA Properties

Resin Properties	Typical Value (English)	Typical Value (SI)	Test Based On
Density (g/cm ³)	0.956	0.956	ExxonMobil Method
Melt Index (g/10 min)	45	45	
Vinyl Acetate Content (wt %)	33.0	33.0	
Peak Melting Temperature	144°F	62°C	

Table A4 EVA Molded Properties

Molded Properties	Typical Value (English)	Typical Value (SI)	Test Based On
Tensile Modulus (0.2 in/min (5.0 mm/min))	1300 psi	9.0 MPa	ASTM D638
Tensile Strength at Break (20 in/min (500 mm/min))	> 580 psi	> 4.0 MPa	ASTM D638
Elongation at Break (20 in/min (500 mm/min))	> 750 %	> 750 %	ASTM D638
Durometer Hardness (Shore A)	65	65	ASTM D2240

Processing Statement

Molded properties were measured on 2 mm thick compression molded plaques prepared base on D4703 Procedure C (Tensile ASTM D638: Type IV dumbbell, Hardness ASTM D2240: 3 plied up disks).

Triacetin [28]

Product Description

Triacetin is a clear, colorless acetate ester used for solidification of cellulose acetate fibers, as a carrier for flavor and essence concentrate, as a solvent and plasticizer in cosmetics formulations and for plasticizing, synthetic rubber and cellulose derivatives.

Chemical Composition

Glycerin triacetate

Supply Form

Water-clear-liquid

Table A5 Triacetin typical properties

Properties	Typical Value, Units
Molecular Weight	218
Form	Liquid
Color Pt-Co	10 max.
Refractive Index @ 25°C	1.429-1.431
Specific Gravity @ 25°C	1.154-1.158
Water Content	< 0.05%
Acidity as Acetic Acid	0.002 wt %
Viscosity @ 25°C	17.4 cP
Boiling Point	258°C (496°F)
Appearance	Clear and free of suspended matter
Freezing Point	3.2°C (37.8°F)
Melting Point	-78°C (-108°F)
Solubility in Water @ 25°C	71.7 g/L
Assay	99.5 wt %

Handling & Safety

A receiving inspection is recommended. The product should be stored in its tightly sealed original container in a cool, dry place. Once opened, containers should be resealed tightly after removal of product. Consult material safety datasheet (MSDS) for additional handling information on triacetin.

CIVCO® Thermoplastics [13]

Thermoplastic masks offer a reliable method for accurate positioning and immobilization, providing fixed positioning from imaging through treatment. CIVCO provides an extensive line of high quality thermoplastics that are comfortable, easy to use and cost effective. This guide is designed to make choosing and ordering thermoplastics a quick and easy process. The first step in choosing the right mask is determining which patient positioning system appeals to you, since our ZENTEC and Standard White masks are available in Type-S and Uni-frame while Mastercast Pro and Posicast are only available for the Posifix System.

Table A6 Product specification

Patient Positioning Systems	Type S™ Uni-frame®	Type S Uni-frame	Posifix®	Posifix
Description	Highly conforming to patient contours, this material provides a comfortable cast. It is our most rigid continuous frame mask.	Our core thermoplastic material offers proven performance in a variety of patterns and configurations.	Our most rigid material for drape and mold style masks. This material also offers reduced shrinkage compared to other masks.	This material offers high conformality and moderate hold.
Perforation & Special Features	IMRT Reinforced Thermoplastics™	Tranquility™ Series IMRT Reinforced Thermoplastics Standard Perforation	PR31 SRS Open Faced Mask	PR31 SRS Open Faced Mask Posicast-Lite Posicast-Plus
Thickness Options	2.4 mm 3.2 mm	2.4 mm 3.2 mm	2.3 mm	2.3 mm
Frame Options	Continuous frame	Continuous frame	3 pt frame 5 pt frame	3 pt frame 5 pt frame
Immobilization Options	Head Only Head, Neck & Shoulders	Head Only Head, Neck & Shoulders	Head Only Head, Neck & Shoulders	Head Only Head, Neck & Shoulders

KLARITY[®] Thermoplastics [29]

Klarity[®] Thermoplastics are used during radiation therapy treatment to stabilize patients undergoing radiation therapy. It offers white and green masks which are reinforced to increase the stability of the plastic after it is molded to the patient.

Product benefits

- Softens and sets quickly
- Smooth, strong edges protect patient
- Reusable material can be remodeled and stretched using only hot water
- Least shrinkage of all leading thermoplastic masks
- 50% longer working time for detailed, better-fitting masks
- 100% non-stick surface when heated
- Lower working temperature 160°-165°F
- Stronger than traditional RT thermoplastic masks

Product specifications

S-Frame (Green)

Head/Neck, 9.5"x15.5", 3.2mm (reinforced)

Head/Neck/Shoulder, 19"x24", 3.2mm (reinforced)

Head only, 10.75"x12.5", 3.2mm (reinforced)

Head/Neck/Shoulder, 2.4mm

Head with Extended Neck, 2.4mm (reinforced)

APPENDIX B

Tensile Test

Table B1 Tensile test of PBS-EVA blends at 100/0 blend composition

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	29.35	400.76	106.34
2	29.17	399.05	106.17
3	29.38	398.81	105.35
4	30.06	399.49	104.63
5	29.81	399.17	105.07
Avg.	29.55	399.46	105.91

Table B2 Tensile test of PBS-EVA blends at 90/10 blend composition

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	27.21	376.92	136.41
2	27.77	378.77	136.63
3	27.91	377.32	135.93
4	28.29	378.86	137.11
5	27.98	379.75	137.64
Avg.	27.83	378.32	136.74

Table B3 Tensile test of PBS-EVA blends at 80/20 blend composition

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	25.57	260.11	177.07
2	25.95	261.13	178.17
3	25.06	259.97	177.48
4	25.73	254.32	177.55
5	25.18	260.13	179.62
Avg.	25.49	259.13	177.98

Table B4 Tensile test of PBS-EVA blends at 70/30 blend composition

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	19.89	176.35	235.77
2	19.86	179.64	236.21
3	19.59	180.79	236.43
4	18.84	179.71	237.03
5	18.23	179.80	237.54
Avg.	19.28	179.26	236.59

Table B5 Tensile test of PBS-EVA blends at 50/50 blend composition

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	13.23	140.91	279.42
2	13.63	140.28	277.94
3	12.59	139.31	279.61
4	13.22	139.26	279.63
5	13.03	138.22	277.16
Avg.	13.14	139.59	278.75

Table B6 Tensile test of PBS-EVA blends at 30/70 blend composition

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	12.32	135.94	370.55
2	12.52	135.16	378.87
3	12.54	134.98	378.33
4	12.33	136.42	376.75
5	12.48	135.23	374.28
Avg.	12.44	135.55	375.76

Table B7 Tensile test of PBS-EVA blends at 0/100 blend composition

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	10.32	109.36	450.95
2	10.51	109.13	453.67
3	10.96	108.46	453.78
4	11.01	109.93	454.05
5	11.27	108.17	453.74
Avg.	10.81	109.01	453.24

Table B8 Tensile test of 70/30 blend composition with 5 phr of triacetin

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	18.41	170.89	267.62
2	18.87	168.33	264.74
3	18.71	169.44	274.92
4	18.11	170.34	259.53
5	18.17	168.07	254.53
Avg.	18.45	169.41	264.27

Table B9 Tensile test of 70/30 blend composition with 7 phr of triacetin

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	17.72	161.61	274.62
2	17.43	159.79	279.88
3	17.74	157.69	272.34
4	17.89	158.11	261.91
5	18.10	160.12	278.57
Avg.	17.78	159.46	273.46

Table B10 Tensile test of 70/30 blend composition with 10 phr of triacetin

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	15.37	155.02	289.48
2	15.30	152.49	297.22
3	14.73	149.78	288.62
4	13.82	146.41	290.57
5	14.23	150.46	292.34
Avg.	14.69	150.83	291.64

Table B11 Tensile test after irradiation

	Tensile Strength (MPa)	Young's Modulus (MPa)	% Elongation at break
1	15.52	153.41	289.17
2	15.04	151.97	287.61
3	15.53	150.71	290.28
4	15.19	152.23	288.02
Avg.	15.32	152.08	288.77

APPENDIX C

DSC Results

Table C1 DSC data of CIVCO thermoplastic mask

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
35.009	1.18805	0.52305	3.00396
35.509	1.23371	0.53671	3.00396
36.009	1.27889	0.54805	3.00395
36.509	1.32404	0.55771	3.00394
37.009	1.36899	0.56594	3.00392
37.509	1.41432	0.57306	3.00391
38.009	1.45996	0.57923	3.00389
38.509	1.50613	0.5848	3.00386
39.009	1.55257	0.59011	3.00384
39.509	1.59906	0.59554	3.00381
40.009	1.6454	0.6013	3.00378
40.509	1.69223	0.60759	3.00375
41.009	1.73918	0.61437	3.00371
41.509	1.78598	0.62153	3.00367
42.009	1.83271	0.62912	3.00363
42.509	1.87944	0.63725	3.00359
43.009	1.92596	0.64604	3.00354
43.509	1.97223	0.65565	3.00349
44.009	2.01851	0.66626	3.00344
44.509	2.06473	0.67786	3.00339
45.009	2.11113	0.69025	3.00333
45.509	2.15709	0.70281	3.00327
46.009	2.20334	0.71536	3.00321
46.509	2.2499	0.72776	3.00314
47.009	2.29641	0.73991	3.00308
47.509	2.34244	0.75169	3.00301
48.009	2.38847	0.7633	3.00293
48.509	2.43437	0.7748	3.00286
49.009	2.4802	0.78637	3.00278
49.509	2.52654	0.79827	3.0027
50.009	2.57337	0.8106	3.00261
50.509	2.62055	0.8234	3.00253
51.009	2.66834	0.83678	3.00244
51.509	2.71615	0.85065	3.00235
52.009	2.7644	0.86522	3.00226
52.509	2.81262	0.88048	3.00216
53.009	2.86072	0.89652	3.00206
53.509	2.90886	0.91364	3.00196
54.009	2.95681	0.93206	3.00185
54.509	3.00459	0.95218	3.00175
55.009	3.05251	0.97451	3.00164
55.509	3.10027	0.99908	3.00153

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
56.009	3.14766	1.02573	3.00141
56.509	3.19553	1.05502	3.00129
57.009	3.24362	1.08732	3.00117
57.509	3.29152	1.12317	3.00105
58.009	3.33925	1.1633	3.00093
58.509	3.38668	1.20796	3.0008
59.009	3.43395	1.25733	3.00067
59.509	3.48128	1.31137	3.00054
60.009	3.52889	1.36985	3.0004
60.509	3.57659	1.43192	3.00026
61.009	3.6248	1.49753	3.00012
61.509	3.67309	1.56501	2.99998
62.009	3.72183	1.63289	2.99984
62.509	3.77129	1.6987	2.99969
63.009	3.8209	1.75898	2.99954
63.509	3.87078	1.81218	2.99938
64.009	3.92015	1.85679	2.99923
64.509	3.96916	1.89284	2.99907
65.009	4.01761	1.92026	2.99891
65.509	4.0658	1.93952	2.99875
66.009	4.1143	1.95092	2.99858
66.509	4.16318	1.95364	2.99841
67.009	4.21216	1.94516	2.99824
67.509	4.26117	1.92155	2.99807
68.009	4.30998	1.87926	2.99789
68.509	4.35877	1.81659	2.99771
69.009	4.40751	1.73439	2.99753
69.509	4.45606	1.63463	2.99735
70.009	4.50464	1.51845	2.99716
70.509	4.55322	1.38896	2.99697
71.009	4.60188	1.2529	2.99678
71.509	4.65049	1.12067	2.99659
72.009	4.6994	1.00059	2.99639
72.509	4.74864	0.8981	2.99619
73.009	4.79759	0.81546	2.99599
73.509	4.84731	0.74933	2.99579
74.009	4.89701	0.69818	2.99558
74.509	4.94669	0.65897	2.99538
75.009	4.99701	0.62876	2.99516
75.509	5.04756	0.60593	2.99495
76.009	5.09746	0.58923	2.99473
76.509	5.14674	0.57713	2.99452
77.009	5.19586	0.56829	2.9943
77.509	5.24451	0.56184	2.99407

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (µV/mW)
78.009	5.29317	0.55711	2.99385
78.509	5.34241	0.55372	2.99362
79.009	5.39168	0.55168	2.99339
79.509	5.44107	0.55126	2.99315
80.009	5.49021	0.55249	2.99292
80.509	5.53977	0.55466	2.99268
81.009	5.58991	0.55639	2.99244
81.509	5.64031	0.55638	2.9922
82.009	5.69088	0.55434	2.99195
82.509	5.74149	0.5513	2.9917
83.009	5.79102	0.54875	2.99145
83.509	5.84024	0.54715	2.9912
84.009	5.88966	0.54613	2.99094
84.509	5.93895	0.54536	2.99069
85.009	5.9883	0.54484	2.99043
85.509	6.03788	0.54467	2.99016
86.009	6.08758	0.54475	2.9899
86.509	6.13725	0.54488	2.98963
87.009	6.18721	0.5449	2.98936
87.509	6.23695	0.54476	2.98909
88.009	6.2863	0.54451	2.98882
88.509	6.33538	0.54426	2.98854
89.009	6.38472	0.54406	2.98826
89.509	6.43417	0.54389	2.98798
90.009	6.48387	0.54361	2.98769
90.509	6.53386	0.543	2.98741
91.009	6.58354	0.54191	2.98712
91.509	6.63314	0.5405	2.98683
92.009	6.6833	0.5393	2.98653
92.509	6.73344	0.53883	2.98624
93.009	6.78326	0.53913	2.98594
93.509	6.8327	0.53975	2.98564
94.009	6.88165	0.54023	2.98533
94.509	6.93057	0.54037	2.98503
95.009	6.97971	0.54027	2.98472
95.509	7.02919	0.54004	2.98441
96.009	7.07934	0.53963	2.9841
96.509	7.12942	0.53893	2.98378
97.009	7.1792	0.53804	2.98347
97.509	7.2293	0.53721	2.98315
98.009	7.27952	0.53667	2.98282
98.509	7.32963	0.53645	2.9825
99.009	7.38006	0.53645	2.98217
99.509	7.43082	0.53658	2.98184

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
100.009	7.48208	0.53687	2.98151
100.509	7.53311	0.5374	2.98118
101.009	7.58385	0.53822	2.98084
101.509	7.63427	0.53915	2.98051
102.009	7.68482	0.5398	2.98016
102.509	7.73524	0.53986	2.97982
103.009	7.78561	0.53941	2.97948
103.509	7.83592	0.53881	2.97913
104.009	7.88599	0.53833	2.97878
104.509	7.93585	0.53804	2.97843
105.009	7.98581	0.53796	2.97807
105.509	8.03563	0.53818	2.97772
106.009	8.08587	0.53868	2.97736
106.509	8.13597	0.5392	2.977
107.009	8.18616	0.53947	2.97663
107.509	8.23659	0.53946	2.97627
108.009	8.28678	0.53945	2.9759
108.509	8.33714	0.53951	2.97553
109.009	8.38687	0.53944	2.97515
109.509	8.43697	0.53906	2.97478
110.009	8.48735	0.53856	2.9744
110.509	8.53782	0.53824	2.97402
111.009	8.58837	0.5382	2.97364
111.509	8.63856	0.53836	2.97326
112.009	8.68874	0.5386	2.97287
112.509	8.73943	0.53887	2.97248
113.009	8.79011	0.53929	2.97209
113.509	8.84049	0.53999	2.9717
114.009	8.89106	0.54079	2.9713
114.509	8.94164	0.5413	2.97091
115.009	8.99204	0.54135	2.97051
115.509	9.04233	0.54107	2.9701
116.009	9.0927	0.5406	2.9697
116.509	9.14329	0.54005	2.96929
117.009	9.19351	0.5396	2.96889
117.509	9.24409	0.53941	2.96848
118.009	9.29479	0.53945	2.96806
118.509	9.34499	0.5395	2.96765
119.009	9.39517	0.5394	2.96723
119.509	9.44539	0.53911	2.96681
120.009	9.49502	0.53856	2.96639
120.509	9.54525	0.53773	2.96596
121.009	9.59574	0.53678	2.96554
121.509	9.64682	0.53598	2.96511

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (µV/mW)
122.009	9.69829	0.53533	2.96468
122.509	9.74961	0.53457	2.96425
123.009	9.80051	0.53362	2.96381
123.509	9.85092	0.53279	2.96337
124.009	9.90049	0.53251	2.96294
124.509	9.95049	0.5329	2.96249
125.009	10.00073	0.53373	2.96205
125.509	10.05107	0.53457	2.96161
126.009	10.10134	0.53503	2.96116
126.509	10.15165	0.53496	2.96071
127.009	10.20185	0.53443	2.96026
127.509	10.25204	0.53371	2.9598
128.009	10.30253	0.53308	2.95934
128.509	10.35307	0.5327	2.95889
129.009	10.4035	0.5326	2.95843
129.509	10.45404	0.53271	2.95796
130.009	10.50449	0.53291	2.9575
130.509	10.55425	0.53305	2.95703
131.009	10.60404	0.53306	2.95656
131.509	10.65409	0.53302	2.95609
132.009	10.7044	0.53302	2.95562
132.509	10.75502	0.53307	2.95514
133.009	10.80665	0.53318	2.95466
133.509	10.85842	0.5333	2.95418
134.009	10.90991	0.53343	2.9537
134.509	10.96057	0.53362	2.95322
135.009	11.01083	0.53399	2.95273
135.509	11.06075	0.53461	2.95224
136.009	11.11103	0.53543	2.95175
136.509	11.16156	0.53616	2.95126
137.009	11.21153	0.53652	2.95077
137.509	11.26118	0.53646	2.95027
138.009	11.31065	0.5361	2.94977
138.509	11.36	0.5357	2.94927
139.009	11.40989	0.53553	2.94877
139.509	11.46041	0.53564	2.94827
140.009	11.51122	0.53585	2.94776
140.509	11.5623	0.53578	2.94725
141.009	11.6127	0.53532	2.94674
141.509	11.66349	0.53459	2.94623
142.009	11.71431	0.53379	2.94571
142.509	11.76519	0.53306	2.94519
143.009	11.8161	0.53263	2.94468
143.509	11.86673	0.53265	2.94415

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (µV/mW)
144.009	11.91769	0.53297	2.94363
144.509	11.96894	0.53329	2.94311
145.009	12.01931	0.53361	2.94258
145.509	12.07057	0.53405	2.94205
146.009	12.12191	0.53458	2.94152
146.509	12.17247	0.53501	2.94099
147.009	12.22316	0.53526	2.94045
147.509	12.27314	0.53536	2.93991
148.009	12.32307	0.5354	2.93937
148.509	12.37315	0.53546	2.93883
149.009	12.4235	0.53557	2.93829
149.509	12.47332	0.53566	2.93775
150.009	12.52341	0.53561	2.9372
150.509	12.57345	0.53536	2.93665
151.009	12.62315	0.53489	2.9361
151.509	12.67277	0.53427	2.93555
152.009	12.72306	0.53361	2.93499
152.509	12.77354	0.53308	2.93443
153.009	12.82452	0.53276	2.93388
153.509	12.87543	0.53267	2.93331
154.009	12.92626	0.5327	2.93275
154.509	12.9771	0.5328	2.93219
155.009	13.0277	0.53294	2.93162
155.509	13.07785	0.5331	2.93105
156.009	13.12822	0.53322	2.93048
156.509	13.17882	0.53318	2.92991
157.009	13.22947	0.533	2.92933
157.509	13.28031	0.53289	2.92876
158.009	13.33114	0.53303	2.92818
158.509	13.38205	0.53333	2.9276
159.009	13.43291	0.53362	2.92702
159.509	13.48402	0.53384	2.92643
160.009	13.53443	0.53403	2.92585
160.509	13.58489	0.53421	2.92526
161.009	13.63525	0.5344	2.92467
161.509	13.68527	0.53461	2.92408
162.009	13.73507	0.53485	2.92349
162.509	13.78518	0.53515	2.92289
163.009	13.83571	0.53554	2.92229
163.509	13.88647	0.53601	2.92169
164.009	13.93676	0.53637	2.92109
164.509	13.98745	0.53645	2.92049
165.009	14.03831	0.53631	2.91988
165.509	14.08897	0.53617	2.91928

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
166.009	14.13917	0.53615	2.91867
166.509	14.19007	0.53616	2.91806
167.009	14.24108	0.53609	2.91745
167.509	14.29219	0.53602	2.91683
168.009	14.3434	0.53612	2.91622
168.509	14.39432	0.53651	2.9156
169.009	14.44486	0.53698	2.91498
169.509	14.49522	0.53719	2.91436
170.009	14.5447	0.53704	2.91373
170.509	14.59455	0.53675	2.91311
171.009	14.64469	0.53657	2.91248
171.509	14.69449	0.53655	2.91185
172.009	14.74352	0.53664	2.91122
172.509	14.79314	0.5368	2.91059
173.009	14.84297	0.53702	2.90996
173.509	14.89255	0.53738	2.90932
174.009	14.94238	0.53799	2.90868
174.509	14.99213	0.53889	2.90804
175.009	15.04184	0.53992	2.9074
175.509	15.09204	0.54084	2.90676
176.009	15.14243	0.54152	2.90611
176.509	15.19281	0.54195	2.90547
177.009	15.24444	0.54217	2.90482
177.509	15.29599	0.54226	2.90417
178.009	15.34788	0.54231	2.90351
178.509	15.39985	0.54236	2.90286
179.009	15.45102	0.54246	2.9022
179.509	15.50213	0.54259	2.90155
180.009	15.55235	0.54276	2.90089
180.509	15.60206	0.54295	2.90023
181.009	15.65212	0.54327	2.89956
181.509	15.70229	0.54383	2.8989
182.009	15.75215	0.5447	2.89823
182.509	15.80177	0.54561	2.89756
183.009	15.85161	0.54611	2.89689
183.509	15.90158	0.54605	2.89622
184.009	15.95139	0.5458	2.89555
184.509	16.0009	0.54574	2.89488
185.009	16.05106	0.54586	2.8942
185.509	16.10101	0.54594	2.89352
186.009	16.15162	0.54587	2.89284
186.509	16.20175	0.54574	2.89216
187.009	16.25238	0.54563	2.89147
187.509	16.30351	0.54566	2.89079

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (µV/mW)
188.009	16.35438	0.54584	2.8901
188.509	16.40406	0.54603	2.88941
189.009	16.45415	0.54609	2.88872
189.509	16.50396	0.54592	2.88803
190.009	16.5538	0.54539	2.88734
190.509	16.60285	0.54438	2.88664
191.009	16.65282	0.54296	2.88594
191.509	16.70314	0.54157	2.88525
192.009	16.75351	0.54061	2.88455
192.509	16.80319	0.5403	2.88384
193.009	16.8536	0.54059	2.88314
193.509	16.90394	0.54124	2.88243
194.009	16.95449	0.5419	2.88173
194.509	17.0047	0.54233	2.88102
195.009	17.05565	0.54252	2.88031
195.509	17.10682	0.54257	2.8796
196.009	17.1582	0.5426	2.87888
196.509	17.20928	0.54266	2.87817
197.009	17.26029	0.54277	2.87745
197.509	17.31118	0.54302	2.87673
198.009	17.362	0.54337	2.87601
198.509	17.4118	0.5436	2.87529
199.009	17.46243	0.54348	2.87456
199.509	17.51289	0.54291	2.87384
200.009	17.56398	0.54201	2.87311
200.509	17.61442	0.54122	2.87238
201.009	17.66501	0.54108	2.87165
201.509	17.71542	0.54175	2.87092
202.009	17.76565	0.54282	2.87019
202.509	17.81486	0.54367	2.86945
203.009	17.86488	0.54412	2.86872
203.509	17.91548	0.54423	2.86798
204.009	17.96618	0.54423	2.86724
204.509	18.01621	0.5443	2.8665
205.009	18.06664	0.54448	2.86576
205.509	18.11674	0.54466	2.86501
206.009	18.16677	0.54475	2.86427
206.509	18.21608	0.54471	2.86352
207.009	18.26612	0.54456	2.86277
207.509	18.31642	0.54436	2.86202
208.009	18.36715	0.5442	2.86127
208.509	18.41738	0.54423	2.86051
209.009	18.4682	0.54456	2.85976
209.509	18.5191	0.5451	2.859

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (µV/mW)
210.009	18.56986	0.5456	2.85824
210.509	18.61995	0.54582	2.85748
211.009	18.67044	0.54581	2.85672
211.509	18.7211	0.5458	2.85596
212.009	18.77153	0.54598	2.85519
212.509	18.82091	0.54635	2.85443
213.009	18.87029	0.5468	2.85366
213.509	18.9199	0.54722	2.85289
214.009	18.9696	0.54757	2.85212
214.509	19.01877	0.54785	2.85135
215.009	19.06924	0.54813	2.85058
215.509	19.11986	0.54849	2.8498
216.009	19.17085	0.54902	2.84902
216.509	19.22071	0.54969	2.84825
217.009	19.27119	0.55045	2.84747
217.509	19.32155	0.55122	2.84669
218.009	19.3722	0.552	2.8459
218.509	19.42269	0.5527	2.84512
219.009	19.47379	0.55321	2.84433
219.509	19.52512	0.55342	2.84355
220.009	19.57609	0.55329	2.84276
220.509	19.62586	0.55291	2.84197
221.009	19.67598	0.55242	2.84118
221.509	19.72627	0.55202	2.84038
222.009	19.77689	0.55186	2.83959
222.509	19.82626	0.55194	2.83879
223.009	19.87657	0.55222	2.838
223.509	19.92666	0.55268	2.8372
224.009	19.97681	0.55334	2.8364
224.509	20.02579	0.55411	2.8356
225.009	20.07543	0.55484	2.83479
225.509	20.1255	0.55539	2.83399
226.009	20.17599	0.55574	2.83318
226.509	20.22524	0.55601	2.83238
227.009	20.27561	0.55625	2.83157
227.509	20.32562	0.55654	2.83076
228.009	20.3758	0.55696	2.82995
228.509	20.42575	0.55761	2.82913
229.009	20.47635	0.55845	2.82832
229.509	20.52699	0.55922	2.8275
230.009	20.57784	0.55957	2.82669
230.509	20.62739	0.5594	2.82587
231.009	20.67772	0.55887	2.82505
231.509	20.72826	0.55833	2.82423

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
232.009	20.77914	0.55802	2.8234
232.509	20.82897	0.558	2.82258
233.009	20.87933	0.55814	2.82175
233.509	20.92954	0.5583	2.82093
234.009	20.97937	0.55831	2.8201
234.509	21.02827	0.55811	2.81927
235.009	21.07793	0.55765	2.81844
235.509	21.12796	0.55701	2.81761
236.009	21.17773	0.55635	2.81677
236.509	21.22806	0.55577	2.81594
237.009	21.27909	0.55527	2.8151
237.509	21.32979	0.55467	2.81427
238.009	21.38015	0.55368	2.81343
238.509	21.43043	0.55221	2.81259
239.009	21.4813	0.55043	2.81174
239.509	21.53264	0.54866	2.8109

Table C2 DSC data of Klarity thermoplastic mask

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (µV/mW)
35	1.09495	0.15886	3.00396
35.5	1.14163	0.16245	3.00396
36	1.18833	0.16586	3.00395
36.5	1.23464	0.16917	3.00394
37	1.28106	0.17249	3.00392
37.5	1.32726	0.17589	3.00391
38	1.3738	0.17954	3.00389
38.5	1.42087	0.18354	3.00386
39	1.46778	0.18786	3.00384
39.5	1.51468	0.19266	3.00381
40	1.56201	0.19833	3.00378
40.5	1.60935	0.2052	3.00375
41	1.6566	0.21337	3.00371
41.5	1.70438	0.22272	3.00367
42	1.75223	0.23261	3.00363
42.5	1.80005	0.24239	3.00359
43	1.84806	0.25172	3.00354
43.5	1.89596	0.26042	3.00349
44	1.94411	0.26849	3.00344
44.5	1.99199	0.2758	3.00339
45	2.04001	0.28246	3.00333
45.5	2.08775	0.28873	3.00327
46	2.13546	0.29518	3.00321
46.5	2.18287	0.30233	3.00314
47	2.23076	0.31075	3.00308
47.5	2.27808	0.32041	3.00301
48	2.32598	0.33153	3.00293
48.5	2.37379	0.34384	3.00286
49	2.42124	0.3572	3.00278
49.5	2.46874	0.37173	3.0027
50	2.5172	0.38785	3.00261
50.5	2.56553	0.40545	3.00253
51	2.61424	0.42485	3.00244
51.5	2.66327	0.44613	3.00235
52	2.71219	0.46899	3.00226
52.5	2.76058	0.49295	3.00216
53	2.80904	0.51785	3.00206
53.5	2.85769	0.54319	3.00196
54	2.90654	0.56844	3.00185
54.5	2.95566	0.5933	3.00175
55	3.00526	0.61773	3.00164
55.5	3.05439	0.64108	3.00153

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
56	3.10321	0.66296	3.00141
56.5	3.15183	0.68272	3.00129
57	3.20046	0.69978	3.00117
57.5	3.24932	0.71366	3.00105
58	3.29817	0.72389	3.00093
58.5	3.34707	0.73029	3.0008
59	3.39557	0.73283	3.00067
59.5	3.44396	0.73172	3.00054
60	3.49219	0.72742	3.0004
60.5	3.54047	0.72068	3.00026
61	3.58874	0.71244	3.00012
61.5	3.63724	0.70329	2.99998
62	3.68626	0.69269	2.99984
62.5	3.7354	0.6783	2.99969
63	3.78477	0.6558	2.99954
63.5	3.83446	0.62068	2.99938
64	3.88387	0.57194	2.99923
64.5	3.93318	0.5127	2.99907
65	3.98279	0.44908	2.99891
65.5	4.03248	0.38843	2.99875
66	4.08223	0.33557	2.99858
66.5	4.13191	0.29237	2.99841
67	4.18151	0.25841	2.99824
67.5	4.23133	0.23215	2.99807
68	4.28067	0.21231	2.99789
68.5	4.33004	0.19715	2.99771
69	4.37959	0.18554	2.99753
69.5	4.42889	0.17682	2.99735
70	4.47801	0.17038	2.99716
70.5	4.52705	0.16568	2.99697
71	4.57641	0.1622	2.99678
71.5	4.62527	0.15949	2.99659
72	4.67424	0.15715	2.99639
72.5	4.72348	0.15511	2.99619
73	4.77323	0.15356	2.99599
73.5	4.8232	0.1526	2.99579
74	4.87318	0.15217	2.99558
74.5	4.92305	0.15209	2.99538
75	4.97269	0.15217	2.99516
75.5	5.0223	0.15229	2.99495
76	5.07222	0.15241	2.99473
76.5	5.12213	0.15247	2.99452
77	5.17269	0.15243	2.9943
77.5	5.22263	0.15231	2.99407

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
78	5.27251	0.15222	2.99385
78.5	5.32278	0.15234	2.99362
79	5.37238	0.15285	2.99339
79.5	5.42217	0.15395	2.99315
80	5.47286	0.15575	2.99292
80.5	5.52312	0.15798	2.99268
81	5.57376	0.16006	2.99244
81.5	5.62434	0.16122	2.9922
82	5.6743	0.16127	2.99195
82.5	5.72413	0.16067	2.9917
83	5.77313	0.16007	2.99145
83.5	5.822	0.15972	2.9912
84	5.87116	0.15958	2.99094
84.5	5.92019	0.15955	2.99069
85	5.96895	0.15956	2.99043
85.5	6.01812	0.15956	2.99016
86	6.06768	0.15949	2.9899
86.5	6.11791	0.15928	2.98963
87	6.16892	0.15885	2.98936
87.5	6.21997	0.15825	2.98909
88	6.27105	0.15772	2.98882
88.5	6.32158	0.15754	2.98854
89	6.37186	0.15769	2.98826
89.5	6.42216	0.1579	2.98798
90	6.47207	0.15799	2.98769
90.5	6.52226	0.15802	2.98741
91	6.5724	0.15805	2.98712
91.5	6.62252	0.15802	2.98683
92	6.67272	0.15789	2.98653
92.5	6.72296	0.1578	2.98624
93	6.77305	0.15792	2.98594
93.5	6.8235	0.15826	2.98564
94	6.87412	0.15857	2.98533
94.5	6.92449	0.15861	2.98503
95	6.97499	0.15836	2.98472
95.5	7.02522	0.15795	2.98441
96	7.07536	0.15757	2.9841
96.5	7.12525	0.15736	2.98378
97	7.17514	0.15737	2.98347
97.5	7.22465	0.15755	2.98315
98	7.27436	0.15781	2.98282
98.5	7.32428	0.15812	2.9825
99	7.37435	0.15849	2.98217
99.5	7.42521	0.15884	2.98184

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
100	7.47692	0.15897	2.98151
100.5	7.52849	0.15875	2.98118
101	7.57944	0.15825	2.98084
101.5	7.62992	0.15769	2.98051
102	7.68019	0.15722	2.98016
102.5	7.73019	0.15682	2.97982
103	7.78065	0.15632	2.97948
103.5	7.83103	0.15563	2.97913
104	7.88157	0.15484	2.97878
104.5	7.93188	0.15411	2.97843
105	7.98186	0.15353	2.97807
105.5	8.03201	0.15311	2.97772
106	8.08273	0.15285	2.97736
106.5	8.13357	0.15269	2.977
107	8.18495	0.1526	2.97663
107.5	8.23628	0.15254	2.97627
108	8.28722	0.15256	2.9759
108.5	8.33803	0.15266	2.97553
109	8.38816	0.15278	2.97515
109.5	8.43795	0.15287	2.97478
110	8.48807	0.1529	2.9744
110.5	8.538	0.1529	2.97402
111	8.58846	0.1529	2.97364
111.5	8.63873	0.1529	2.97326
112	8.68948	0.1529	2.97287
112.5	8.73987	0.15292	2.97248
113	8.78993	0.15298	2.97209
113.5	8.84025	0.15313	2.9717
114	8.89068	0.1534	2.9713
114.5	8.94113	0.15371	2.97091
115	8.99184	0.15394	2.97051
115.5	9.04255	0.15401	2.9701
116	9.09327	0.15395	2.9697
116.5	9.1441	0.15378	2.96929
117	9.1953	0.15357	2.96889
117.5	9.24624	0.15338	2.96848
118	9.2967	0.15325	2.96806
118.5	9.34726	0.15318	2.96765
119	9.39777	0.15316	2.96723
119.5	9.44819	0.15311	2.96681
120	9.49915	0.15296	2.96639
120.5	9.55011	0.15268	2.96596
121	9.60071	0.15235	2.96554
121.5	9.65143	0.15211	2.96511

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
122	9.70168	0.15206	2.96468
122.5	9.75111	0.15212	2.96425
123	9.80045	0.15214	2.96381
123.5	9.85032	0.15205	2.96337
124	9.89989	0.15186	2.96294
124.5	9.95017	0.15155	2.96249
125	10.00123	0.15111	2.96205
125.5	10.05206	0.15061	2.96161
126	10.10241	0.1502	2.96116
126.5	10.15279	0.14993	2.96071
127	10.20324	0.1498	2.96026
127.5	10.25408	0.14975	2.9598
128	10.30504	0.14975	2.95934
128.5	10.35613	0.14977	2.95889
129	10.40721	0.14979	2.95843
129.5	10.45783	0.14984	2.95796
130	10.50858	0.14997	2.9575
130.5	10.55859	0.15021	2.95703
131	10.60883	0.15052	2.95656
131.5	10.65897	0.15085	2.95609
132	10.70934	0.1511	2.95562
132.5	10.75958	0.15121	2.95514
133	10.81001	0.15115	2.95466
133.5	10.86038	0.15099	2.95418
134	10.9103	0.15087	2.9537
134.5	10.96016	0.15082	2.95322
135	11.00987	0.15083	2.95273
135.5	11.05981	0.1509	2.95224
136	11.11009	0.15113	2.95175
136.5	11.16074	0.15149	2.95126
137	11.21123	0.15183	2.95077
137.5	11.26234	0.15206	2.95027
138	11.3131	0.15217	2.94977
138.5	11.36364	0.15223	2.94927
139	11.41359	0.15226	2.94877
139.5	11.46371	0.15233	2.94827
140	11.51375	0.15254	2.94776
140.5	11.56407	0.15286	2.94725
141	11.61407	0.15319	2.94674
141.5	11.66431	0.1535	2.94623
142	11.71462	0.15383	2.94571
142.5	11.76497	0.15412	2.94519
143	11.81551	0.15432	2.94468
143.5	11.86661	0.15439	2.94415

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
144	11.91747	0.15444	2.94363
144.5	11.9679	0.15454	2.94311
145	12.01763	0.1548	2.94258
145.5	12.06733	0.15533	2.94205
146	12.11702	0.1561	2.94152
146.5	12.16731	0.15692	2.94099
147	12.21741	0.15765	2.94045
147.5	12.26751	0.15834	2.93991
148	12.31782	0.15915	2.93937
148.5	12.36832	0.16006	2.93883
149	12.41908	0.16096	2.93829
149.5	12.46953	0.16166	2.93775
150	12.52033	0.16213	2.9372
150.5	12.57111	0.16238	2.93665
151	12.62182	0.16249	2.9361
151.5	12.67206	0.16255	2.93555
152	12.72248	0.16261	2.93499
152.5	12.77231	0.1627	2.93443
153	12.82227	0.16289	2.93388
153.5	12.87157	0.16327	2.93331
154	12.92105	0.1639	2.93275
154.5	12.9702	0.16469	2.93219
155	13.01975	0.16547	2.93162
155.5	13.069	0.16605	2.93105
156	13.11895	0.1664	2.93048
156.5	13.16995	0.16657	2.92991
157	13.22108	0.16671	2.92933
157.5	13.27173	0.1669	2.92876
158	13.32196	0.16721	2.92818
158.5	13.37263	0.16766	2.9276
159	13.42358	0.16821	2.92702
159.5	13.47483	0.16871	2.92643
160	13.52612	0.16896	2.92585
160.5	13.57714	0.16902	2.92526
161	13.62751	0.16923	2.92467
161.5	13.67777	0.16985	2.92408
162	13.72769	0.17076	2.92349
162.5	13.77784	0.17161	2.92289
163	13.82797	0.17209	2.92229
163.5	13.87841	0.17227	2.92169
164	13.92836	0.17246	2.92109
164.5	13.97852	0.17295	2.92049
165	14.02882	0.1737	2.91988
165.5	14.07882	0.17447	2.91928

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
166	14.12882	0.17515	2.91867
166.5	14.17931	0.17586	2.91806
167	14.22963	0.17681	2.91745
167.5	14.27983	0.17817	2.91683
168	14.3295	0.17998	2.91622
168.5	14.37904	0.18221	2.9156
169	14.42913	0.18475	2.91498
169.5	14.47989	0.18743	2.91436
170	14.53031	0.19001	2.91373
170.5	14.58143	0.19233	2.91311
171	14.63258	0.19428	2.91248
171.5	14.68341	0.1961	2.91185
172	14.73405	0.19837	2.91122
172.5	14.78477	0.20147	2.91059
173	14.83566	0.20545	2.90996
173.5	14.88714	0.21003	2.90932
174	14.93802	0.21478	2.90868
174.5	14.98861	0.21968	2.90804
175	15.03922	0.22493	2.9074
175.5	15.08967	0.23063	2.90676
176	15.13962	0.23652	2.90611
176.5	15.18984	0.2424	2.90547
177	15.24048	0.24813	2.90482
177.5	15.2908	0.25359	2.90417
178	15.34104	0.25876	2.90351
178.5	15.39129	0.26368	2.90286
179	15.44178	0.26865	2.9022
179.5	15.49273	0.27387	2.90155
180	15.54358	0.27899	2.90089
180.5	15.59412	0.28341	2.90023
181	15.64531	0.28693	2.89956
181.5	15.69618	0.28967	2.8989
182	15.74675	0.29197	2.89823
182.5	15.79624	0.29408	2.89756
183	15.84599	0.29621	2.89689
183.5	15.89579	0.29848	2.89622
184	15.94566	0.30096	2.89555
184.5	15.99584	0.30362	2.89488
185	16.04679	0.30643	2.8942
185.5	16.09799	0.3095	2.89352
186	16.14943	0.31358	2.89284
186.5	16.20013	0.31936	2.89216
187	16.25034	0.3262	2.89147
187.5	16.30018	0.33171	2.89079

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
188	16.34986	0.33389	2.8901
188.5	16.39865	0.33318	2.88941
189	16.44849	0.33152	2.88872
189.5	16.49912	0.33044	2.88803
190	16.55049	0.3304	2.88734
190.5	16.60088	0.33116	2.88664
191	16.6517	0.33259	2.88594
191.5	16.70263	0.3347	2.88525
192	16.75307	0.33748	2.88455
192.5	16.80257	0.34078	2.88384
193	16.85312	0.34459	2.88314
193.5	16.90365	0.34882	2.88243
194	16.95443	0.35365	2.88173
194.5	17.00444	0.35912	2.88102
195	17.05503	0.36523	2.88031
195.5	17.10511	0.37134	2.8796
196	17.15534	0.37697	2.87888
196.5	17.20516	0.38165	2.87817
197	17.25573	0.38552	2.87745
197.5	17.30655	0.38896	2.87673
198	17.35758	0.39239	2.87601
198.5	17.40776	0.39573	2.87529
199	17.45835	0.39894	2.87456
199.5	17.50934	0.40207	2.87384
200	17.5605	0.40523	2.87311
200.5	17.61102	0.40835	2.87238
201	17.66179	0.41142	2.87165
201.5	17.71243	0.41433	2.87092
202	17.76252	0.41697	2.87019
202.5	17.81174	0.41935	2.86945
203	17.86172	0.42175	2.86872
203.5	17.91141	0.42427	2.86798
204	17.96094	0.42689	2.86724
204.5	18.01	0.42935	2.8665
205	18.05948	0.43159	2.86576
205.5	18.10931	0.4337	2.86501
206	18.15959	0.43578	2.86427
206.5	18.20947	0.43768	2.86352
207	18.26027	0.43918	2.86277
207.5	18.31082	0.44013	2.86202
208	18.36136	0.44073	2.86127
208.5	18.4108	0.44124	2.86051
209	18.46058	0.44187	2.85976
209.5	18.51028	0.44263	2.859

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
210	18.56046	0.44335	2.85824
210.5	18.6101	0.44377	2.85748
211	18.6605	0.44368	2.85672
211.5	18.71138	0.44303	2.85596
212	18.76244	0.44198	2.85519
212.5	18.81281	0.44094	2.85443
213	18.86354	0.4403	2.85366
213.5	18.91408	0.44034	2.85289
214	18.96443	0.441	2.85212
214.5	19.01368	0.44191	2.85135
215	19.06379	0.44255	2.85058
215.5	19.11428	0.44245	2.8498
216	19.16558	0.44153	2.84902
216.5	19.21652	0.44026	2.84825
217	19.26779	0.43923	2.84747
217.5	19.31873	0.43879	2.84669
218	19.36951	0.43866	2.8459
218.5	19.41949	0.43824	2.84512
219	19.46998	0.4374	2.84433
219.5	19.52035	0.43652	2.84355
220	19.57097	0.43599	2.84276
220.5	19.62109	0.43582	2.84197
221	19.67163	0.43583	2.84118
221.5	19.72216	0.43584	2.84038
222	19.77316	0.4357	2.83959
222.5	19.82259	0.43535	2.83879
223	19.87285	0.43485	2.838
223.5	19.92343	0.43445	2.8372
224	19.97416	0.43433	2.8364
224.5	20.02385	0.43442	2.8356
225	20.07399	0.4344	2.83479
225.5	20.12419	0.4341	2.83399
226	20.17495	0.43363	2.83318
226.5	20.22456	0.43319	2.83238
227	20.27517	0.4329	2.83157
227.5	20.32538	0.43285	2.83076
228	20.37581	0.43303	2.82995
228.5	20.42525	0.43333	2.82913
229	20.47519	0.43361	2.82832
229.5	20.52542	0.43382	2.8275
230	20.5757	0.43396	2.82669
230.5	20.62505	0.43397	2.82587
231	20.67536	0.43378	2.82505
231.5	20.72619	0.43335	2.82423

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
232	20.777	0.43277	2.8234
232.5	20.82693	0.43213	2.82258
233	20.87726	0.43132	2.82175
233.5	20.92787	0.43018	2.82093
234	20.97788	0.42879	2.8201
234.5	21.02764	0.42741	2.81927
235	21.07813	0.42629	2.81844
235.5	21.12818	0.42569	2.81761
236	21.17798	0.42573	2.81677
236.5	21.22748	0.42632	2.81594
237	21.27712	0.4271	2.8151
237.5	21.3271	0.42764	2.81427
238	21.37705	0.42764	2.81343
238.5	21.42722	0.42697	2.81259
239	21.47823	0.42566	2.81174
239.5	21.52974	0.42398	2.8109
240	21.58069	0.42254	2.81006

Table C3 DSC data of polybutylene succinate

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
35	1.3051	0.1228	3.00396
35.5	1.35162	0.16295	3.00396
36	1.39497	0.19704	3.00395
36.5	1.43774	0.22635	3.00394
37	1.48093	0.2515	3.00392
37.5	1.52472	0.27282	3.00391
38	1.56916	0.29072	3.00389
38.5	1.61424	0.3056	3.00386
39	1.65925	0.31772	3.00384
39.5	1.70462	0.32768	3.00381
40	1.75036	0.33588	3.00378
40.5	1.79613	0.34261	3.00375
41	1.84144	0.34816	3.00371
41.5	1.88697	0.35297	3.00367
42	1.93221	0.35728	3.00363
42.5	1.97722	0.36126	3.00359
43	2.02217	0.36501	3.00354
43.5	2.06703	0.36857	3.00349
44	2.11151	0.37199	3.00344
44.5	2.15611	0.37534	3.00339
45	2.20102	0.3786	3.00333
45.5	2.24574	0.38172	3.00327
46	2.29054	0.38463	3.00321
46.5	2.33553	0.38719	3.00314
47	2.38049	0.38934	3.00308
47.5	2.42529	0.39113	3.00301
48	2.47048	0.3927	3.00293
48.5	2.51595	0.39414	3.00286
49	2.56181	0.3955	3.00278
49.5	2.60805	0.39681	3.0027
50	2.65424	0.39814	3.00261
50.5	2.70022	0.39955	3.00253
51	2.74632	0.40108	3.00244
51.5	2.79229	0.40267	3.00235
52	2.83816	0.40417	3.00226
52.5	2.88426	0.40544	3.00216
53	2.93077	0.40643	3.00206
53.5	2.97725	0.4072	3.00196
54	3.02411	0.40791	3.00185
54.5	3.0709	0.40869	3.00175
55	3.11811	0.40954	3.00164
55.5	3.16548	0.41034	3.00153

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
56	3.21307	0.41107	3.00141
56.5	3.26128	0.41192	3.00129
57	3.30955	0.41314	3.00117
57.5	3.3577	0.41476	3.00105
58	3.40571	0.41659	3.00093
58.5	3.45338	0.41833	3.0008
59	3.50081	0.41979	3.00067
59.5	3.54802	0.42092	3.00054
60	3.59509	0.42169	3.0004
60.5	3.64233	0.42214	3.00026
61	3.69035	0.42242	3.00012
61.5	3.73842	0.42274	2.99998
62	3.7867	0.42326	2.99984
62.5	3.83536	0.42408	2.99969
63	3.88402	0.42513	2.99954
63.5	3.93221	0.42627	2.99938
64	3.98066	0.42729	2.99923
64.5	4.02914	0.42804	2.99907
65	4.07758	0.42854	2.99891
65.5	4.12606	0.4289	2.99875
66	4.17447	0.4291	2.99858
66.5	4.223	0.42905	2.99841
67	4.27154	0.42871	2.99824
67.5	4.32048	0.42812	2.99807
68	4.36924	0.42741	2.99789
68.5	4.41775	0.42674	2.99771
69	4.46583	0.42623	2.99753
69.5	4.51355	0.4258	2.99735
70	4.56118	0.42528	2.99716
70.5	4.60888	0.42456	2.99697
71	4.65668	0.42369	2.99678
71.5	4.70488	0.42267	2.99659
72	4.75306	0.42135	2.99639
72.5	4.80162	0.41963	2.99619
73	4.85077	0.41774	2.99599
73.5	4.89972	0.41613	2.99579
74	4.94799	0.41507	2.99558
74.5	4.99622	0.41442	2.99538
75	5.04402	0.41387	2.99516
75.5	5.09191	0.41309	2.99495
76	5.14013	0.4119	2.99473
76.5	5.18869	0.41025	2.99452
77	5.2379	0.40817	2.9943
77.5	5.28701	0.40583	2.99407

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
78	5.33662	0.40341	2.99385
78.5	5.38672	0.40109	2.99362
79	5.43689	0.39885	2.99339
79.5	5.48666	0.39644	2.99315
80	5.53618	0.39355	2.99292
80.5	5.58523	0.38999	2.99268
81	5.63418	0.38557	2.99244
81.5	5.68323	0.3802	2.9922
82	5.73229	0.37384	2.99195
82.5	5.78176	0.36627	2.9917
83	5.83119	0.3572	2.99145
83.5	5.88107	0.34618	2.9912
84	5.93074	0.33324	2.99094
84.5	5.98048	0.31817	2.99069
85	6.03013	0.30048	2.99043
85.5	6.07981	0.27929	2.99016
86	6.12978	0.25369	2.9899
86.5	6.17974	0.22364	2.98963
87	6.23026	0.18966	2.98936
87.5	6.28035	0.15484	2.98909
88	6.33003	0.1232	2.98882
88.5	6.38011	9.89E-02	2.98854
89	6.43065	8.58E-02	2.98826
89.5	6.4807	8.52E-02	2.98798
90	6.53092	9.54E-02	2.98769
90.5	6.58107	0.11336	2.98741
91	6.6307	0.13577	2.98712
91.5	6.68024	0.16024	2.98683
92	6.72964	0.18479	2.98653
92.5	6.77922	0.20814	2.98624
93	6.82841	0.22935	2.98594
93.5	6.87764	0.24852	2.98564
94	6.92732	0.26596	2.98533
94.5	6.97667	0.28162	2.98503
95	7.0265	0.2961	2.98472
95.5	7.07658	0.30978	2.98441
96	7.12672	0.32312	2.9841
96.5	7.17665	0.33651	2.98378
97	7.22624	0.35019	2.98347
97.5	7.27546	0.36428	2.98315
98	7.32463	0.37894	2.98282
98.5	7.37448	0.39443	2.9825
99	7.42515	0.4107	2.98217
99.5	7.47621	0.42762	2.98184

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
100	7.52699	0.44513	2.98151
100.5	7.57767	0.46352	2.98118
101	7.62788	0.48271	2.98084
101.5	7.6777	0.50254	2.98051
102	7.72789	0.52306	2.98016
102.5	7.77808	0.54386	2.97982
103	7.82808	0.56477	2.97948
103.5	7.87821	0.58599	2.97913
104	7.92862	0.60776	2.97878
104.5	7.97916	0.63018	2.97843
105	8.0296	0.65325	2.97807
105.5	8.07984	0.67704	2.97772
106	8.1302	0.70186	2.97736
106.5	8.18015	0.72757	2.977
107	8.23012	0.75443	2.97663
107.5	8.28015	0.78249	2.97627
108	8.33014	0.81173	2.9759
108.5	8.37997	0.84241	2.97553
109	8.42943	0.87504	2.97515
109.5	8.47953	0.91186	2.97478
110	8.53008	0.95662	2.9744
110.5	8.58043	1.01739	2.97402
111	8.63118	1.10989	2.97364
111.5	8.68195	1.24798	2.97326
112	8.73227	1.42653	2.97287
112.5	8.7826	1.61751	2.97248
113	8.83313	1.78376	2.97209
113.5	8.88351	1.90714	2.9717
114	8.93368	1.99893	2.9713
114.5	8.9837	2.0765	2.97091
115	9.03379	2.14211	2.97051
115.5	9.08316	2.18213	2.9701
116	9.13295	2.1831	2.9697
116.5	9.18272	2.13691	2.96929
117	9.23259	2.043	2.96889
117.5	9.28242	1.9066	2.96848
118	9.33239	1.73555	2.96806
118.5	9.38236	1.53951	2.96765
119	9.43264	1.32664	2.96723
119.5	9.4827	1.11196	2.96681
120	9.5329	0.91173	2.96639
120.5	9.58368	0.74173	2.96596
121	9.63419	0.61334	2.96554
121.5	9.68484	0.52307	2.96511

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
122	9.7349	0.46353	2.96468
122.5	9.7853	0.42455	2.96425
123	9.83584	0.39945	2.96381
123.5	9.88618	0.38362	2.96337
124	9.93633	0.37394	2.96294
124.5	9.98655	0.3682	2.96249
125	10.03684	0.3648	2.96205
125.5	10.08692	0.36265	2.96161
126	10.13725	0.3612	2.96116
126.5	10.18783	0.3603	2.96071
127	10.23802	0.35992	2.96026
127.5	10.28852	0.3598	2.9598
128	10.33902	0.35963	2.95934
128.5	10.38931	0.35925	2.95889
129	10.43986	0.35885	2.95843
129.5	10.49035	0.35877	2.95796
130	10.54087	0.35904	2.9575
130.5	10.5918	0.35924	2.95703
131	10.64293	0.35897	2.95656
131.5	10.69407	0.35828	2.95609
132	10.74527	0.35757	2.95562
132.5	10.79579	0.35711	2.95514
133	10.84591	0.35682	2.95466
133.5	10.89618	0.35656	2.95418
134	10.94675	0.3563	2.9537
134.5	10.99711	0.35617	2.95322
135	11.04763	0.35633	2.95273
135.5	11.09847	0.35688	2.95224
136	11.14863	0.35779	2.95175
136.5	11.19855	0.35893	2.95126
137	11.24836	0.36002	2.95077
137.5	11.29825	0.36085	2.95027
138	11.3477	0.36142	2.94977
138.5	11.39751	0.36185	2.94927
139	11.44687	0.36224	2.94877
139.5	11.4964	0.36256	2.94827
140	11.54662	0.36282	2.94776
140.5	11.59728	0.36308	2.94725
141	11.64809	0.36338	2.94674
141.5	11.69956	0.36356	2.94623
142	11.75084	0.36346	2.94571
142.5	11.80233	0.36317	2.94519
143	11.8535	0.36308	2.94468
143.5	11.90428	0.36346	2.94415

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
144	11.95499	0.3642	2.94363
144.5	12.0054	0.36501	2.94311
145	12.05548	0.36572	2.94258
145.5	12.10563	0.36636	2.94205
146	12.15569	0.36691	2.94152
146.5	12.20644	0.36724	2.94099
147	12.25671	0.36733	2.94045
147.5	12.30686	0.36744	2.93991
148	12.35719	0.36771	2.93937
148.5	12.40753	0.36795	2.93883
149	12.45775	0.36793	2.93829
149.5	12.5071	0.36766	2.93775
150	12.55701	0.36734	2.9372
150.5	12.60712	0.36712	2.93665
151	12.65749	0.36703	2.9361
151.5	12.70753	0.36709	2.93555
152	12.758	0.36732	2.93499
152.5	12.80865	0.36779	2.93443
153	12.85883	0.36856	2.93388
153.5	12.90933	0.36965	2.93331
154	12.96041	0.37089	2.93275
154.5	13.01135	0.37189	2.93219
155	13.06209	0.37251	2.93162
155.5	13.11234	0.37289	2.93105
156	13.1621	0.37328	2.93048
156.5	13.21191	0.37383	2.92991
157	13.26183	0.37453	2.92933
157.5	13.3122	0.37522	2.92876
158	13.36257	0.37572	2.92818
158.5	13.41332	0.376	2.9276
159	13.46409	0.37607	2.92702
159.5	13.5144	0.376	2.92643
160	13.56464	0.37593	2.92585
160.5	13.61473	0.37605	2.92526
161	13.66508	0.37648	2.92467
161.5	13.71559	0.3773	2.92408
162	13.7659	0.37851	2.92349
162.5	13.81653	0.37995	2.92289
163	13.86744	0.38123	2.92229
163.5	13.91817	0.38208	2.92169
164	13.96831	0.38257	2.92109
164.5	14.01884	0.38292	2.92049
165	14.06925	0.38321	2.91988
165.5	14.1195	0.38338	2.91928

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
166	14.16957	0.38328	2.91867
166.5	14.21999	0.38294	2.91806
167	14.27031	0.3826	2.91745
167.5	14.32049	0.38257	2.91683
168	14.36975	0.38289	2.91622
168.5	14.41935	0.38337	2.9156
169	14.46919	0.38373	2.91498
169.5	14.51916	0.38383	2.91436
170	14.56882	0.38378	2.91373
170.5	14.61872	0.38375	2.91311
171	14.66869	0.38379	2.91248
171.5	14.71866	0.38383	2.91185
172	14.76893	0.38361	2.91122
172.5	14.81946	0.3829	2.91059
173	14.87026	0.38167	2.90996
173.5	14.92131	0.38036	2.90932
174	14.97166	0.37961	2.90868
174.5	15.0215	0.37967	2.90804
175	15.07122	0.38028	2.9074
175.5	15.12074	0.38099	2.90676
176	15.17059	0.3815	2.90611
176.5	15.22023	0.38175	2.90547
177	15.27092	0.38183	2.90482
177.5	15.32174	0.3818	2.90417
178	15.37236	0.38171	2.90351
178.5	15.4226	0.38165	2.90286
179	15.47317	0.38169	2.9022
179.5	15.52375	0.38175	2.90155
180	15.57425	0.38165	2.90089
180.5	15.62484	0.38141	2.90023
181	15.67542	0.38122	2.89956
181.5	15.72561	0.38129	2.8989
182	15.77627	0.38181	2.89823
182.5	15.82615	0.38266	2.89756
183	15.87625	0.38338	2.89689
183.5	15.92647	0.3836	2.89622
184	15.9767	0.38354	2.89555
184.5	16.02591	0.3836	2.89488
185	16.07601	0.38377	2.8942
185.5	16.12608	0.38363	2.89352
186	16.17672	0.38289	2.89284
186.5	16.22636	0.38181	2.89216
187	16.27671	0.38085	2.89147
187.5	16.32692	0.38034	2.89079

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
188	16.3772	0.38028	2.8901
188.5	16.42669	0.38043	2.88941
189	16.477	0.38046	2.88872
189.5	16.52733	0.38021	2.88803
190	16.57817	0.37988	2.88734
190.5	16.62861	0.37978	2.88664
191	16.67933	0.37997	2.88594
191.5	16.72988	0.38025	2.88525
192	16.78082	0.38044	2.88455
192.5	16.83175	0.38055	2.88384
193	16.88313	0.38065	2.88314
193.5	16.93461	0.3808	2.88243
194	16.98621	0.38102	2.88173
194.5	17.03581	0.38125	2.88102
195	17.08599	0.38148	2.88031
195.5	17.13628	0.38175	2.8796
196	17.18655	0.38205	2.87888
196.5	17.23653	0.38227	2.87817
197	17.28687	0.38229	2.87745
197.5	17.33667	0.38211	2.87673
198	17.38643	0.38187	2.87601
198.5	17.43539	0.38175	2.87529
199	17.48506	0.3818	2.87456
199.5	17.53578	0.38191	2.87384
200	17.58673	0.382	2.87311
200.5	17.63674	0.38208	2.87238
201	17.68736	0.38212	2.87165
201.5	17.7379	0.38201	2.87092
202	17.78858	0.3818	2.87019
202.5	17.83875	0.38175	2.86945
203	17.88918	0.38201	2.86872
203.5	17.93949	0.38243	2.86798
204	17.98963	0.38277	2.86724
204.5	18.03928	0.38292	2.8665
205	18.08929	0.38294	2.86576
205.5	18.13953	0.38288	2.86501
206	18.18973	0.38276	2.86427
206.5	18.23895	0.38258	2.86352
207	18.2885	0.38237	2.86277
207.5	18.33824	0.38218	2.86202
208	18.38828	0.38206	2.86127
208.5	18.43749	0.38208	2.86051
209	18.48705	0.38227	2.85976
209.5	18.53731	0.38254	2.859

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
210	18.58827	0.3826	2.85824
210.5	18.6385	0.38216	2.85748
211	18.68954	0.38118	2.85672
211.5	18.74001	0.38012	2.85596
212	18.78983	0.37958	2.85519
212.5	18.83921	0.37977	2.85443
213	18.88922	0.3803	2.85366
213.5	18.94028	0.38043	2.85289
214	18.99218	0.37968	2.85212
214.5	19.04388	0.37835	2.85135
215	19.09583	0.37699	2.85058
215.5	19.14725	0.37593	2.8498
216	19.19848	0.3752	2.84902
216.5	19.24868	0.37476	2.84825
217	19.29932	0.37453	2.84747
217.5	19.35026	0.37434	2.84669
218	19.40064	0.37398	2.8459
218.5	19.45009	0.37334	2.84512
219	19.50017	0.37241	2.84433
219.5	19.55031	0.37125	2.84355
220	19.60065	0.36992	2.84276
220.5	19.64992	0.36859	2.84197
221	19.70015	0.36743	2.84118
221.5	19.75068	0.36663	2.84038
222	19.80094	0.36619	2.83959
222.5	19.85058	0.36588	2.83879
223	19.90124	0.36535	2.838
223.5	19.95152	0.36439	2.8372
224	20.00176	0.36303	2.8364
224.5	20.05135	0.36145	2.8356
225	20.1011	0.35975	2.83479
225.5	20.1508	0.35804	2.83399
226	20.20082	0.35651	2.83318
226.5	20.2499	0.35534	2.83238
227	20.30027	0.35435	2.83157
227.5	20.35106	0.35323	2.83076
228	20.40251	0.35176	2.82995
228.5	20.45341	0.34997	2.82913
229	20.50446	0.34797	2.82832
229.5	20.55512	0.34593	2.8275
230	20.60574	0.3439	2.82669
230.5	20.65528	0.34192	2.82587
231	20.70516	0.34009	2.82505
231.5	20.75534	0.33869	2.82423

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
232	20.80527	0.33787	2.8234
232.5	20.85424	0.33745	2.82258
233	20.90447	0.33705	2.82175
233.5	20.9549	0.33642	2.82093
234	21.0053	0.33554	2.8201
234.5	21.05544	0.33457	2.81927
235	21.1062	0.33359	2.81844
235.5	21.15651	0.33276	2.81761
236	21.20738	0.3323	2.81677
236.5	21.25749	0.33242	2.81594
237	21.30812	0.33308	2.8151
237.5	21.35875	0.33392	2.81427
238	21.40907	0.33457	2.81343
238.5	21.45933	0.33489	2.81259
239	21.51048	0.3351	2.81174
239.5	21.56137	0.33569	2.8109
240	21.61134	0.33703	2.81006

Table C4 DSC data of ethylene vinyl acetate

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
30	0.59296	0.30815	3.00388
30.5	0.63951	0.35117	3.0039
31	0.68703	0.38586	3.00392
31.5	0.73597	0.41332	3.00393
32	0.78541	0.43467	3.00394
32.5	0.83428	0.45127	3.00395
33	0.8828	0.46443	3.00396
33.5	0.93078	0.47482	3.00397
34	0.97839	0.48296	3.00397
34.5	1.02579	0.48935	3.00397
35	1.0734	0.49454	3.00396
35.5	1.12129	0.49892	3.00396
36	1.16946	0.50272	3.00395
36.5	1.21742	0.50602	3.00394
37	1.26562	0.50899	3.00392
37.5	1.31362	0.51177	3.00391
38	1.36133	0.51449	3.00389
38.5	1.40887	0.51716	3.00386
39	1.45646	0.51966	3.00384
39.5	1.50401	0.52176	3.00381
40	1.55157	0.52329	3.00378
40.5	1.59954	0.52439	3.00375
41	1.64771	0.52536	3.00371
41.5	1.69628	0.52659	3.00367
42	1.74536	0.52833	3.00363
42.5	1.79431	0.53054	3.00359
43	1.84331	0.53304	3.00354
43.5	1.89172	0.53552	3.00349
44	1.94066	0.53787	3.00344
44.5	1.98928	0.53995	3.00339
45	2.0382	0.5418	3.00333
45.5	2.08707	0.54373	3.00327
46	2.13577	0.54616	3.00321
46.5	2.18424	0.54931	3.00314
47	2.2326	0.55322	3.00308
47.5	2.28135	0.55795	3.00301
48	2.33018	0.56352	3.00293
48.5	2.37882	0.56982	3.00286
49	2.42722	0.57644	3.00278
49.5	2.4751	0.58286	3.0027
50	2.52271	0.58882	3.00261
50.5	2.57077	0.59444	3.00253

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
51	2.61925	0.59999	3.00244
51.5	2.66765	0.60592	3.00235
52	2.71675	0.61283	3.00226
52.5	2.76571	0.62069	3.00216
53	2.81491	0.62897	3.00206
53.5	2.86385	0.63673	3.00196
54	2.91328	0.64342	3.00185
54.5	2.96301	0.64876	3.00175
55	3.01288	0.6528	3.00164
55.5	3.06254	0.65578	3.00153
56	3.11196	0.65787	3.00141
56.5	3.1611	0.65898	3.00129
57	3.2096	0.65904	3.00117
57.5	3.25828	0.65828	3.00105
58	3.30732	0.65713	3.00093
58.5	3.35646	0.65599	3.0008
59	3.4054	0.65502	3.00067
59.5	3.45434	0.65413	3.00054
60	3.50304	0.6532	3.0004
60.5	3.55147	0.65228	3.00026
61	3.59994	0.65146	3.00012
61.5	3.64899	0.65088	2.99998
62	3.6982	0.65065	2.99984
62.5	3.74772	0.65073	2.99969
63	3.79747	0.651	2.99954
63.5	3.84742	0.65128	2.99938
64	3.89762	0.65153	2.99923
64.5	3.94763	0.65186	2.99907
65	3.99775	0.65235	2.99891
65.5	4.04769	0.65306	2.99875
66	4.09748	0.65409	2.99858
66.5	4.1473	0.65555	2.99841
67	4.19662	0.65741	2.99824
67.5	4.24608	0.6596	2.99807
68	4.29563	0.66202	2.99789
68.5	4.34513	0.66456	2.99771
69	4.39489	0.66704	2.99753
69.5	4.44404	0.66917	2.99735
70	4.49298	0.67086	2.99716
70.5	4.54217	0.67221	2.99697
71	4.59174	0.67347	2.99678
71.5	4.64112	0.6749	2.99659
72	4.69104	0.67665	2.99639
72.5	4.74082	0.67867	2.99619

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
73	4.79102	0.68107	2.99599
73.5	4.84167	0.68411	2.99579
74	4.89202	0.68789	2.99558
74.5	4.94225	0.69229	2.99538
75	4.99179	0.69696	2.99516
75.5	5.04115	0.70176	2.99495
76	5.09047	0.70669	2.99473
76.5	5.14029	0.71181	2.99452
77	5.19046	0.71718	2.9943
77.5	5.24058	0.72294	2.99407
78	5.29086	0.72951	2.99385
78.5	5.34054	0.73708	2.99362
79	5.3899	0.74551	2.99339
79.5	5.43944	0.75433	2.99315
80	5.48906	0.76294	2.99292
80.5	5.53868	0.77121	2.99268
81	5.58835	0.77937	2.99244
81.5	5.63748	0.78762	2.9922
82	5.68696	0.79619	2.99195
82.5	5.73642	0.80502	2.9917
83	5.78575	0.81399	2.99145
83.5	5.83547	0.82291	2.9912
84	5.8857	0.83144	2.99094
84.5	5.93571	0.83927	2.99069
85	5.98602	0.84648	2.99043
85.5	6.03648	0.85302	2.99016
86	6.08673	0.85877	2.9899
86.5	6.13677	0.86377	2.98963
87	6.18735	0.8682	2.98936
87.5	6.23742	0.87179	2.98909
88	6.28731	0.87359	2.98882
88.5	6.33782	0.8722	2.98854
89	6.38787	0.86701	2.98826
89.5	6.43779	0.8585	2.98798
90	6.48806	0.84684	2.98769
90.5	6.53829	0.83126	2.98741
91	6.58814	0.8106	2.98712
91.5	6.63843	0.78392	2.98683
92	6.6887	0.75205	2.98653
92.5	6.73936	0.71626	2.98624
93	6.79001	0.67876	2.98594
93.5	6.84074	0.64131	2.98564
94	6.89137	0.60557	2.98533
94.5	6.94188	0.5728	2.98503

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
95	6.99206	0.54399	2.98472
95.5	7.04225	0.51933	2.98441
96	7.09264	0.49875	2.9841
96.5	7.14238	0.4823	2.98378
97	7.19194	0.46926	2.98347
97.5	7.24179	0.45893	2.98315
98	7.29191	0.45104	2.98282
98.5	7.3417	0.44557	2.9825
99	7.39207	0.44202	2.98217
99.5	7.44246	0.43959	2.98184
100	7.49268	0.4375	2.98151
100.5	7.54309	0.43554	2.98118
101	7.59341	0.43401	2.98084
101.5	7.64381	0.43314	2.98051
102	7.69442	0.4328	2.98016
102.5	7.7449	0.43261	2.97982
103	7.79549	0.43226	2.97948
103.5	7.84601	0.43169	2.97913
104	7.89611	0.4311	2.97878
104.5	7.94636	0.43066	2.97843
105	7.99651	0.43043	2.97807
105.5	8.0469	0.43037	2.97772
106	8.09761	0.43037	2.97736
106.5	8.14814	0.43037	2.977
107	8.1993	0.43033	2.97663
107.5	8.24987	0.43027	2.97627
108	8.30019	0.43027	2.9759
108.5	8.35078	0.43038	2.97553
109	8.40036	0.43055	2.97515
109.5	8.45002	0.43071	2.97478
110	8.50006	0.43083	2.9744
110.5	8.55005	0.43093	2.97402
111	8.60031	0.43101	2.97364
111.5	8.65059	0.43108	2.97326
112	8.70106	0.43115	2.97287
112.5	8.75157	0.43123	2.97248
113	8.80187	0.43131	2.97209
113.5	8.85183	0.43145	2.9717
114	8.90176	0.43172	2.9713
114.5	8.95165	0.43204	2.97091
115	9.0022	0.43217	2.97051
115.5	9.05292	0.43191	2.9701
116	9.10355	0.43136	2.9697
116.5	9.15475	0.43076	2.96929

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
117	9.20581	0.43034	2.96889
117.5	9.25644	0.43029	2.96848
118	9.30715	0.43063	2.96806
118.5	9.35774	0.43116	2.96765
119	9.40798	0.43159	2.96723
119.5	9.45786	0.43184	2.96681
120	9.50768	0.4319	2.96639
120.5	9.55693	0.43178	2.96596
121	9.60639	0.43149	2.96554
121.5	9.65641	0.43117	2.96511
122	9.70583	0.43103	2.96468
122.5	9.75578	0.43112	2.96425
123	9.80568	0.4312	2.96381
123.5	9.85589	0.43084	2.96337
124	9.90596	0.43001	2.96294
124.5	9.95612	0.42919	2.96249
125	10.0064	0.42897	2.96205
125.5	10.05671	0.42941	2.96161
126	10.10664	0.43009	2.96116
126.5	10.15669	0.43055	2.96071
127	10.20696	0.43043	2.96026
127.5	10.25775	0.42958	2.9598
128	10.30892	0.42828	2.95934
128.5	10.3604	0.4271	2.95889
129	10.41155	0.42643	2.95843
129.5	10.46249	0.4263	2.95796
130	10.51286	0.42663	2.9575
130.5	10.56282	0.42742	2.95703
131	10.61267	0.42864	2.95656
131.5	10.66241	0.42994	2.95609
132	10.71253	0.43084	2.95562
132.5	10.76281	0.43103	2.95514
133	10.81348	0.4307	2.95466
133.5	10.8642	0.43023	2.95418
134	10.9147	0.42987	2.9537
134.5	10.96506	0.42964	2.95322
135	11.01556	0.42948	2.95273
135.5	11.06626	0.42937	2.95224
136	11.1177	0.42933	2.95175
136.5	11.16886	0.42944	2.95126
137	11.21975	0.42983	2.95077
137.5	11.27034	0.43063	2.95027
138	11.32025	0.43175	2.94977
138.5	11.36991	0.43277	2.94927

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
139	11.4188	0.43321	2.94877
139.5	11.46826	0.43301	2.94827
140	11.51791	0.43259	2.94776
140.5	11.56784	0.43248	2.94725
141	11.61787	0.43282	2.94674
141.5	11.66855	0.43323	2.94623
142	11.71907	0.43316	2.94571
142.5	11.77007	0.43248	2.94519
143	11.82124	0.43151	2.94468
143.5	11.87232	0.43075	2.94415
144	11.92375	0.43041	2.94363
144.5	11.97452	0.4304	2.94311
145	12.02454	0.43036	2.94258
145.5	12.07466	0.43008	2.94205
146	12.12486	0.42959	2.94152
146.5	12.17539	0.42913	2.94099
147	12.22614	0.42888	2.94045
147.5	12.27658	0.42885	2.93991
148	12.3273	0.42898	2.93937
148.5	12.37716	0.42921	2.93883
149	12.427	0.4294	2.93829
149.5	12.47681	0.42939	2.93775
150	12.52663	0.42918	2.9372
150.5	12.57687	0.42895	2.93665
151	12.62768	0.42888	2.9361
151.5	12.67804	0.42903	2.93555
152	12.72856	0.42928	2.93499
152.5	12.77875	0.42956	2.93443
153	12.82883	0.42985	2.93388
153.5	12.87845	0.43014	2.93331
154	12.92849	0.43034	2.93275
154.5	12.97902	0.43039	2.93219
155	13.02953	0.43041	2.93162
155.5	13.08002	0.43059	2.93105
156	13.13061	0.43103	2.93048
156.5	13.18141	0.43177	2.92991
157	13.23209	0.43282	2.92933
157.5	13.28258	0.43399	2.92876
158	13.3331	0.4348	2.92818
158.5	13.38368	0.43494	2.9276
159	13.43435	0.43463	2.92702
159.5	13.48493	0.43433	2.92643
160	13.5349	0.43422	2.92585
160.5	13.58501	0.43412	2.92526

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
161	13.6353	0.43391	2.92467
161.5	13.68557	0.43378	2.92408
162	13.73621	0.43389	2.92349
162.5	13.78705	0.43428	2.92289
163	13.83727	0.43496	2.92229
163.5	13.88768	0.43593	2.92169
164	13.93685	0.4369	2.92109
164.5	13.98637	0.43753	2.92049
165	14.03599	0.43765	2.91988
165.5	14.08626	0.43739	2.91928
166	14.13617	0.43689	2.91867
166.5	14.18705	0.43614	2.91806
167	14.23813	0.43533	2.91745
167.5	14.28936	0.4349	2.91683
168	14.33988	0.43518	2.91622
168.5	14.39069	0.43601	2.9156
169	14.44137	0.43703	2.91498
169.5	14.49161	0.43795	2.91436
170	14.54149	0.43854	2.91373
170.5	14.59134	0.43868	2.91311
171	14.64128	0.43841	2.91248
171.5	14.69145	0.43799	2.91185
172	14.74168	0.43773	2.91122
172.5	14.79257	0.43799	2.91059
173	14.84323	0.43891	2.90996
173.5	14.89364	0.44027	2.90932
174	14.9438	0.44145	2.90868
174.5	14.99374	0.44196	2.90804
175	15.04385	0.44188	2.9074
175.5	15.09424	0.44166	2.90676
176	15.14456	0.44175	2.90611
176.5	15.19473	0.44234	2.90547
177	15.24564	0.44354	2.90482
177.5	15.29635	0.44538	2.90417
178	15.34668	0.44754	2.90351
178.5	15.39685	0.44927	2.90286
179	15.44669	0.44982	2.9022
179.5	15.49613	0.44913	2.90155
180	15.54591	0.44783	2.90089
180.5	15.59484	0.44663	2.90023
181	15.64454	0.44558	2.89956
181.5	15.69485	0.44434	2.8989
182	15.74566	0.44266	2.89823
182.5	15.79635	0.44085	2.89756

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
183	15.84707	0.43963	2.89689
183.5	15.89768	0.43957	2.89622
184	15.94803	0.4405	2.89555
184.5	15.99773	0.4416	2.89488
185	16.04831	0.44206	2.8942
185.5	16.09881	0.44148	2.89352
186	16.14948	0.44002	2.89284
186.5	16.19995	0.43824	2.89216
187	16.25072	0.43676	2.89147
187.5	16.30181	0.43603	2.89079
188	16.35272	0.43635	2.8901
188.5	16.40268	0.43778	2.88941
189	16.45235	0.4398	2.88872
189.5	16.50189	0.44153	2.88803
190	16.55184	0.44253	2.88734
190.5	16.6013	0.443	2.88664
191	16.65183	0.44336	2.88594
191.5	16.70251	0.4437	2.88525
192	16.75315	0.44395	2.88455
192.5	16.80311	0.44407	2.88384
193	16.85317	0.44411	2.88314
193.5	16.90338	0.44409	2.88243
194	16.95428	0.44392	2.88173
194.5	17.0044	0.44356	2.88102
195	17.05554	0.4431	2.88031
195.5	17.10659	0.4428	2.8796
196	17.15722	0.44278	2.87888
196.5	17.20668	0.44295	2.87817
197	17.25676	0.44312	2.87745
197.5	17.30762	0.44307	2.87673
198	17.359	0.44273	2.87601
198.5	17.41029	0.44236	2.87529
199	17.46179	0.44207	2.87456
199.5	17.51266	0.44167	2.87384
200	17.56289	0.4411	2.87311
200.5	17.61243	0.44062	2.87238
201	17.66252	0.44035	2.87165
201.5	17.713	0.44011	2.87092
202	17.76367	0.43969	2.87019
202.5	17.81341	0.43907	2.86945
203	17.86404	0.43817	2.86872
203.5	17.91454	0.43693	2.86798
204	17.96494	0.43529	2.86724
204.5	18.01512	0.43323	2.8665

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
205	18.06632	0.43073	2.86576
205.5	18.11752	0.42809	2.86501
206	18.16919	0.42571	2.86427
206.5	18.22022	0.42413	2.86352
207	18.27153	0.42364	2.86277
207.5	18.32258	0.42411	2.86202
208	18.37348	0.42508	2.86127
208.5	18.42343	0.42624	2.86051
209	18.47342	0.42753	2.85976
209.5	18.52336	0.42885	2.859
210	18.57331	0.43014	2.85824
210.5	18.62198	0.43142	2.85748
211	18.67115	0.43285	2.85672
211.5	18.72007	0.43428	2.85596
212	18.76915	0.4353	2.85519
212.5	18.81789	0.43537	2.85443
213	18.86786	0.43429	2.85366
213.5	18.918	0.43248	2.85289
214	18.96829	0.43062	2.85212
214.5	19.01814	0.42901	2.85135
215	19.06792	0.42746	2.85058
215.5	19.11808	0.42565	2.8498
216	19.16895	0.42339	2.84902
216.5	19.21955	0.42071	2.84825
217	19.2709	0.41791	2.84747
217.5	19.32245	0.41563	2.84669
218	19.37408	0.41428	2.8459
218.5	19.42507	0.41366	2.84512
219	19.47637	0.41324	2.84433
219.5	19.52722	0.41255	2.84355
220	19.57814	0.41135	2.84276
220.5	19.62751	0.40964	2.84197
221	19.67723	0.40737	2.84118
221.5	19.72735	0.40451	2.84038
222	19.77767	0.40096	2.83959
222.5	19.8273	0.39658	2.83879
223	19.87745	0.39116	2.838
223.5	19.92727	0.38498	2.8372
224	19.9771	0.3783	2.8364
224.5	20.02577	0.37143	2.8356
225	20.07516	0.3642	2.83479
225.5	20.12504	0.35684	2.83399
226	20.17552	0.34978	2.83318
226.5	20.22479	0.34394	2.83238

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
227	20.27503	0.33993	2.83157
227.5	20.32519	0.33848	2.83076
228	20.37535	0.33954	2.82995
228.5	20.42463	0.34267	2.82913
229	20.47532	0.34786	2.82832
229.5	20.52604	0.35498	2.8275
230	20.5764	0.36352	2.82669
230.5	20.62553	0.37242	2.82587
231	20.67529	0.38119	2.82505
231.5	20.72463	0.38914	2.82423
232	20.77446	0.39618	2.8234
232.5	20.82426	0.40219	2.82258
233	20.87466	0.40724	2.82175
233.5	20.92511	0.41127	2.82093
234	20.9752	0.41432	2.8201
234.5	21.02516	0.4167	2.81927
235	21.07574	0.41902	2.81844
235.5	21.12653	0.42203	2.81761
236	21.17715	0.42615	2.81677
236.5	21.22724	0.43114	2.81594
237	21.27768	0.43636	2.8151
237.5	21.32821	0.44096	2.81427
238	21.37875	0.44424	2.81343
238.5	21.42935	0.44605	2.81259
239	21.48037	0.44679	2.81174
239.5	21.53181	0.44728	2.8109
240	21.58243	0.44826	2.81006

Table C5 DSC data of the 70/30 of PBS/EVA blends

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
35	1.11524	0.38026	3.00396
35.5	1.16336	0.38316	3.00396
36	1.21081	0.38614	3.00395
36.5	1.25797	0.38904	3.00394
37	1.30492	0.39175	3.00392
37.5	1.35221	0.39424	3.00391
38	1.40006	0.39657	3.00389
38.5	1.44785	0.39884	3.00386
39	1.49582	0.40119	3.00384
39.5	1.54382	0.40365	3.00381
40	1.5914	0.40621	3.00378
40.5	1.6388	0.40886	3.00375
41	1.68669	0.41153	3.00371
41.5	1.73446	0.41408	3.00367
42	1.78265	0.41644	3.00363
42.5	1.83086	0.4186	3.00359
43	1.87952	0.4207	3.00354
43.5	1.92826	0.4229	3.00349
44	1.97677	0.42528	3.00344
44.5	2.02505	0.42778	3.00339
45	2.07336	0.43035	3.00333
45.5	2.1216	0.43298	3.00327
46	2.17035	0.43579	3.00321
46.5	2.21912	0.43885	3.00314
47	2.26743	0.44224	3.00308
47.5	2.31563	0.44607	3.00301
48	2.36301	0.45032	3.00293
48.5	2.40986	0.45493	3.00286
49	2.45705	0.45978	3.00278
49.5	2.50464	0.46463	3.0027
50	2.55298	0.46937	3.00261
50.5	2.60204	0.47401	3.00253
51	2.65198	0.47865	3.00244
51.5	2.70237	0.48323	3.00235
52	2.75272	0.48767	3.00226
52.5	2.80264	0.49198	3.00216
53	2.85174	0.49614	3.00206
53.5	2.90059	0.50009	3.00196
54	2.94903	0.50362	3.00185
54.5	2.99786	0.50663	3.00175
55	3.04733	0.50911	3.00164
55.5	3.09713	0.5111	3.00153

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
56	3.14683	0.51269	3.00141
56.5	3.19594	0.51395	3.00129
57	3.24505	0.51491	3.00117
57.5	3.29388	0.51551	3.00105
58	3.34293	0.51564	3.00093
58.5	3.39202	0.51537	3.0008
59	3.44097	0.51495	3.00067
59.5	3.4896	0.51461	3.00054
60	3.53823	0.51436	3.0004
60.5	3.58636	0.51414	3.00026
61	3.63496	0.51391	3.00012
61.5	3.68372	0.51365	2.99998
62	3.73291	0.51327	2.99984
62.5	3.78203	0.51266	2.99969
63	3.83201	0.51187	2.99954
63.5	3.8818	0.51126	2.99938
64	3.93147	0.51111	2.99923
64.5	3.98133	0.51133	2.99907
65	4.03123	0.51166	2.99891
65.5	4.08117	0.5119	2.99875
66	4.13122	0.51202	2.99858
66.5	4.18126	0.51206	2.99841
67	4.23093	0.51202	2.99824
67.5	4.28022	0.51197	2.99807
68	4.32936	0.51195	2.99789
68.5	4.37888	0.51199	2.99771
69	4.42849	0.51206	2.99753
69.5	4.47804	0.51212	2.99735
70	4.52756	0.51217	2.99716
70.5	4.57703	0.51223	2.99697
71	4.62659	0.51234	2.99678
71.5	4.6766	0.51257	2.99659
72	4.72611	0.51296	2.99639
72.5	4.77573	0.51351	2.99619
73	4.82537	0.51416	2.99599
73.5	4.87487	0.51485	2.99579
74	4.92429	0.51562	2.99558
74.5	4.97413	0.51662	2.99538
75	5.02427	0.51793	2.99516
75.5	5.07479	0.51953	2.99495
76	5.12529	0.52127	2.99473
76.5	5.17552	0.52309	2.99452
77	5.2254	0.52503	2.9943
77.5	5.27492	0.5272	2.99407

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
78	5.3246	0.52963	2.99385
78.5	5.37459	0.53224	2.99362
79	5.42451	0.53489	2.99339
79.5	5.4743	0.53744	2.99315
80	5.52433	0.53991	2.99292
80.5	5.57434	0.54232	2.99268
81	5.62448	0.54478	2.99244
81.5	5.67439	0.54733	2.9922
82	5.72444	0.54993	2.99195
82.5	5.77465	0.55236	2.9917
83	5.82448	0.55449	2.99145
83.5	5.87487	0.55647	2.9912
84	5.92527	0.55847	2.99094
84.5	5.97587	0.56051	2.99069
85	6.02609	0.56243	2.99043
85.5	6.07651	0.5641	2.99016
86	6.12722	0.56537	2.9899
86.5	6.1777	0.56609	2.98963
87	6.22835	0.56622	2.98936
87.5	6.2787	0.56572	2.98909
88	6.32901	0.56449	2.98882
88.5	6.3791	0.56238	2.98854
89	6.42914	0.55915	2.98826
89.5	6.47942	0.5543	2.98798
90	6.52916	0.54737	2.98769
90.5	6.57891	0.53775	2.98741
91	6.62913	0.52497	2.98712
91.5	6.67969	0.50888	2.98683
92	6.72992	0.48993	2.98653
92.5	6.78022	0.46851	2.98624
93	6.83035	0.44536	2.98594
93.5	6.87997	0.42138	2.98564
94	6.92966	0.39709	2.98533
94.5	6.97957	0.37356	2.98503
95	7.02973	0.3522	2.98472
95.5	7.08013	0.3344	2.98441
96	7.1307	0.32104	2.9841
96.5	7.18103	0.31245	2.98378
97	7.23102	0.30844	2.98347
97.5	7.28062	0.30877	2.98315
98	7.33003	0.31326	2.98282
98.5	7.37925	0.3216	2.9825
99	7.42899	0.33335	2.98217
99.5	7.4789	0.34772	2.98184

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
100	7.52934	0.36416	2.98151
100.5	7.57977	0.38204	2.98118
101	7.62996	0.40093	2.98084
101.5	7.68051	0.42086	2.98051
102	7.73113	0.44168	2.98016
102.5	7.7818	0.46342	2.97982
103	7.8325	0.48608	2.97948
103.5	7.88319	0.50964	2.97913
104	7.93358	0.53383	2.97878
104.5	7.98389	0.55851	2.97843
105	8.03422	0.58336	2.97807
105.5	8.08439	0.60797	2.97772
106	8.13477	0.63221	2.97736
106.5	8.18479	0.65554	2.977
107	8.23521	0.67818	2.97663
107.5	8.28562	0.70007	2.97627
108	8.33608	0.7216	2.9759
108.5	8.38686	0.74334	2.97553
109	8.43748	0.76562	2.97515
109.5	8.48753	0.78883	2.97478
110	8.5374	0.81392	2.9744
110.5	8.58685	0.84213	2.97402
111	8.63602	0.87586	2.97364
111.5	8.68568	0.91927	2.97326
112	8.73538	0.976	2.97287
112.5	8.78572	1.04865	2.97248
113	8.83644	1.13452	2.97209
113.5	8.8867	1.22647	2.9717
114	8.93682	1.31962	2.9713
114.5	8.98734	1.41099	2.97091
115	9.03776	1.495	2.97051
115.5	9.08846	1.56626	2.9701
116	9.13913	1.6186	2.9697
116.5	9.19034	1.64874	2.96929
117	9.24112	1.65341	2.96889
117.5	9.29187	1.62963	2.96848
118	9.34268	1.57363	2.96806
118.5	9.39305	1.48475	2.96765
119	9.44377	1.36474	2.96723
119.5	9.49437	1.22329	2.96681
120	9.54497	1.07369	2.96639
120.5	9.59514	0.93191	2.96596
121	9.64495	0.80891	2.96554
121.5	9.69512	0.7083	2.96511

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
122	9.74426	0.63232	2.96468
122.5	9.7939	0.57508	2.96425
123	9.84404	0.53293	2.96381
123.5	9.89427	0.50263	2.96337
124	9.94466	0.48099	2.96294
124.5	9.99527	0.46551	2.96249
125	10.04562	0.45453	2.96205
125.5	10.09603	0.44675	2.96161
126	10.1458	0.44142	2.96116
126.5	10.19568	0.43775	2.96071
127	10.2461	0.43524	2.96026
127.5	10.29679	0.43358	2.9598
128	10.3476	0.43254	2.95934
128.5	10.39835	0.43192	2.95889
129	10.44835	0.43158	2.95843
129.5	10.49828	0.43131	2.95796
130	10.54828	0.43087	2.9575
130.5	10.598	0.43022	2.95703
131	10.64826	0.42957	2.95656
131.5	10.69869	0.42925	2.95609
132	10.74946	0.42941	2.95562
132.5	10.80023	0.4299	2.95514
133	10.85063	0.43035	2.95466
133.5	10.90124	0.43041	2.95418
134	10.95185	0.42994	2.9537
134.5	11.00275	0.42914	2.95322
135	11.05367	0.42844	2.95273
135.5	11.10419	0.42808	2.95224
136	11.15477	0.42806	2.95175
136.5	11.20504	0.42816	2.95126
137	11.2557	0.42817	2.95077
137.5	11.30714	0.428	2.95027
138	11.35828	0.42786	2.94977
138.5	11.40903	0.42815	2.94927
139	11.45939	0.42911	2.94877
139.5	11.509	0.43065	2.94827
140	11.55895	0.43237	2.94776
140.5	11.6093	0.4338	2.94725
141	11.65925	0.43473	2.94674
141.5	11.70999	0.43523	2.94623
142	11.76078	0.43546	2.94571
142.5	11.81166	0.43561	2.94519
143	11.86219	0.43588	2.94468
143.5	11.91311	0.43638	2.94415

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
144	11.9637	0.43709	2.94363
144.5	12.01427	0.43785	2.94311
145	12.06416	0.4385	2.94258
145.5	12.11395	0.43901	2.94205
146	12.16407	0.43946	2.94152
146.5	12.21409	0.43996	2.94099
147	12.26398	0.44057	2.94045
147.5	12.31415	0.44119	2.93991
148	12.3646	0.44161	2.93937
148.5	12.41537	0.44176	2.93883
149	12.46654	0.44182	2.93829
149.5	12.51741	0.442	2.93775
150	12.56794	0.44228	2.9372
150.5	12.618	0.44252	2.93665
151	12.66824	0.44259	2.9361
151.5	12.71773	0.4425	2.93555
152	12.7676	0.44239	2.93499
152.5	12.81769	0.44244	2.93443
153	12.86769	0.44273	2.93388
153.5	12.91723	0.44313	2.93331
154	12.96673	0.44349	2.93275
154.5	13.01633	0.44374	2.93219
155	13.06627	0.44397	2.93162
155.5	13.11624	0.44436	2.93105
156	13.16596	0.44493	2.93048
156.5	13.21662	0.44545	2.92991
157	13.26748	0.44569	2.92933
157.5	13.31758	0.44573	2.92876
158	13.36795	0.44586	2.92818
158.5	13.41877	0.44621	2.9276
159	13.46924	0.44661	2.92702
159.5	13.52027	0.44693	2.92643
160	13.57125	0.44719	2.92585
160.5	13.62206	0.44751	2.92526
161	13.67249	0.44802	2.92467
161.5	13.72238	0.44873	2.92408
162	13.77117	0.44949	2.92349
162.5	13.82091	0.45009	2.92289
163	13.87129	0.45028	2.92229
163.5	13.92227	0.45007	2.92169
164	13.97303	0.4498	2.92109
164.5	14.02384	0.44989	2.92049
165	14.07413	0.45051	2.91988
165.5	14.1243	0.45146	2.91928

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
166	14.17395	0.45244	2.91867
166.5	14.2238	0.45322	2.91806
167	14.27424	0.45373	2.91745
167.5	14.32468	0.45404	2.91683
168	14.37401	0.45421	2.91622
168.5	14.4247	0.45417	2.9156
169	14.47559	0.45383	2.91498
169.5	14.52656	0.45334	2.91436
170	14.57765	0.45307	2.91373
170.5	14.62812	0.45331	2.91311
171	14.67858	0.45384	2.91248
171.5	14.72877	0.45424	2.91185
172	14.77845	0.45421	2.91122
172.5	14.82856	0.45362	2.91059
173	14.87909	0.45237	2.90996
173.5	14.92946	0.45071	2.90932
174	14.97927	0.44923	2.90868
174.5	15.0293	0.44835	2.90804
175	15.07948	0.44804	2.9074
175.5	15.12969	0.44791	2.90676
176	15.18005	0.44778	2.90611
176.5	15.23077	0.44769	2.90547
177	15.28127	0.44771	2.90482
177.5	15.33166	0.44778	2.90417
178	15.38254	0.44771	2.90351
178.5	15.43305	0.44738	2.90286
179	15.48388	0.44688	2.9022
179.5	15.5351	0.44639	2.90155
180	15.58601	0.44604	2.90089
180.5	15.63599	0.44573	2.90023
181	15.68659	0.4454	2.89956
181.5	15.73723	0.4451	2.8989
182	15.78762	0.44487	2.89823
182.5	15.83742	0.44466	2.89756
183	15.88721	0.44436	2.89689
183.5	15.93715	0.44398	2.89622
184	15.98713	0.44365	2.89555
184.5	16.0371	0.44346	2.89488
185	16.08763	0.44344	2.8942
185.5	16.13795	0.44352	2.89352
186	16.18783	0.44369	2.89284
186.5	16.23705	0.44401	2.89216
187	16.28677	0.44458	2.89147
187.5	16.33666	0.4453	2.89079

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
188	16.38665	0.44582	2.8901
188.5	16.436	0.44583	2.88941
189	16.48601	0.44534	2.88872
189.5	16.53606	0.44463	2.88803
190	16.58643	0.44386	2.88734
190.5	16.63636	0.44306	2.88664
191	16.68656	0.44228	2.88594
191.5	16.73651	0.44167	2.88525
192	16.78699	0.44129	2.88455
192.5	16.83682	0.44111	2.88384
193	16.88756	0.44097	2.88314
193.5	16.93877	0.44089	2.88243
194	16.98963	0.44111	2.88173
194.5	17.03945	0.44168	2.88102
195	17.08972	0.44238	2.88031
195.5	17.13974	0.44282	2.8796
196	17.19017	0.44272	2.87888
196.5	17.24012	0.44212	2.87817
197	17.29051	0.44135	2.87745
197.5	17.34126	0.44078	2.87673
198	17.39237	0.44053	2.87601
198.5	17.44234	0.44053	2.87529
199	17.49306	0.44067	2.87456
199.5	17.54412	0.44099	2.87384
200	17.59478	0.44154	2.87311
200.5	17.64454	0.4422	2.87238
201	17.69519	0.44262	2.87165
201.5	17.74559	0.44245	2.87092
202	17.79621	0.44179	2.87019
202.5	17.84647	0.44117	2.86945
203	17.89707	0.44104	2.86872
203.5	17.94733	0.44149	2.86798
204	17.99756	0.44233	2.86724
204.5	18.04748	0.44316	2.8665
205	18.09754	0.4436	2.86576
205.5	18.1483	0.44344	2.86501
206	18.19899	0.44285	2.86427
206.5	18.24867	0.44225	2.86352
207	18.29883	0.44192	2.86277
207.5	18.34884	0.44188	2.86202
208	18.39893	0.44194	2.86127
208.5	18.4486	0.44189	2.86051
209	18.49892	0.44165	2.85976
209.5	18.54922	0.44125	2.859

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
210	18.59938	0.4408	2.85824
210.5	18.64896	0.44039	2.85748
211	18.69916	0.43996	2.85672
211.5	18.74922	0.43938	2.85596
212	18.79982	0.43846	2.85519
212.5	18.84964	0.43706	2.85443
213	18.90011	0.43514	2.85366
213.5	18.95074	0.43294	2.85289
214	19.00153	0.43074	2.85212
214.5	19.05109	0.42872	2.85135
215	19.10132	0.42675	2.85058
215.5	19.15165	0.42469	2.8498
216	19.20224	0.42233	2.84902
216.5	19.25219	0.41963	2.84825
217	19.30263	0.41669	2.84747
217.5	19.3531	0.41381	2.84669
218	19.40369	0.41112	2.8459
218.5	19.45368	0.40857	2.84512
219	19.50443	0.4059	2.84433
219.5	19.55507	0.40302	2.84355
220	19.60631	0.39982	2.84276
220.5	19.65673	0.3964	2.84197
221	19.70793	0.39276	2.84118
221.5	19.75953	0.389	2.84038
222	19.8109	0.38523	2.83959
222.5	19.86094	0.3815	2.83879
223	19.91149	0.37769	2.838
223.5	19.9618	0.37401	2.8372
224	20.0123	0.37065	2.8364
224.5	20.06182	0.36785	2.8356
225	20.11193	0.36565	2.83479
225.5	20.16224	0.36414	2.83399
226	20.21243	0.36328	2.83318
226.5	20.2615	0.36293	2.83238
227	20.31134	0.3629	2.83157
227.5	20.36152	0.36306	2.83076
228	20.41165	0.36342	2.82995
228.5	20.46117	0.3642	2.82913
229	20.51163	0.36573	2.82832
229.5	20.56193	0.36822	2.8275
230	20.61192	0.37168	2.82669
230.5	20.66131	0.37587	2.82587
231	20.71119	0.38057	2.82505
231.5	20.76111	0.38541	2.82423

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
232	20.81116	0.3903	2.8234
232.5	20.86063	0.39532	2.82258
233	20.91097	0.40074	2.82175
233.5	20.96107	0.40633	2.82093
234	21.01119	0.4118	2.8201
234.5	21.06068	0.4169	2.81927
235	21.11063	0.42166	2.81844
235.5	21.16084	0.42607	2.81761
236	21.21073	0.43008	2.81677
236.5	21.26021	0.43364	2.81594
237	21.31051	0.43674	2.8151
237.5	21.36107	0.43921	2.81427
238	21.41134	0.44115	2.81343
238.5	21.46124	0.44292	2.81259
239	21.51164	0.44485	2.81174
239.5	21.56214	0.44687	2.8109
240	21.61267	0.44877	2.81006

Table C6 DSC data of the 50/50 of PBS/EVA blends

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
35	1.20527	0.32217	3.00396
35.5	1.25088	0.33794	3.00396
36	1.29633	0.35073	3.00395
36.5	1.34209	0.36135	3.00394
37	1.38776	0.3703	3.00392
37.5	1.43355	0.37793	3.00391
38	1.47979	0.38445	3.00389
38.5	1.52595	0.38986	3.00386
39	1.57217	0.39443	3.00384
39.5	1.61863	0.3985	3.00381
40	1.66515	0.4023	3.00378
40.5	1.71184	0.40597	3.00375
41	1.75861	0.40953	3.00371
41.5	1.80522	0.41291	3.00367
42	1.85161	0.41598	3.00363
42.5	1.8976	0.41859	3.00359
43	1.94378	0.42074	3.00354
43.5	1.99039	0.42262	3.00349
44	2.03735	0.42447	3.00344
44.5	2.08477	0.42658	3.00339
45	2.1321	0.42908	3.00333
45.5	2.17862	0.43191	3.00327
46	2.22492	0.435	3.00321
46.5	2.27083	0.43819	3.00314
47	2.31672	0.44138	3.00308
47.5	2.3632	0.44455	3.00301
48	2.41021	0.44779	3.00293
48.5	2.4578	0.45131	3.00286
49	2.50548	0.4553	3.00278
49.5	2.55303	0.45976	3.0027
50	2.60054	0.46453	3.00261
50.5	2.64769	0.46938	3.00253
51	2.69486	0.47417	3.00244
51.5	2.74219	0.47874	3.00235
52	2.78982	0.48301	3.00226
52.5	2.83763	0.48691	3.00216
53	2.88558	0.49048	3.00206
53.5	2.93348	0.4937	3.00196
54	2.9815	0.49648	3.00185
54.5	3.02948	0.49862	3.00175
55	3.07737	0.50004	3.00164
55.5	3.1257	0.50087	3.00153

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
56	3.17393	0.50129	3.00141
56.5	3.22202	0.50149	3.00129
57	3.26986	0.50151	3.00117
57.5	3.31731	0.50132	3.00105
58	3.36504	0.50089	3.00093
58.5	3.41322	0.50015	3.0008
59	3.46151	0.49911	3.00067
59.5	3.51039	0.4979	3.00054
60	3.55865	0.49678	3.0004
60.5	3.60653	0.49594	3.00026
61	3.65395	0.49541	3.00012
61.5	3.70151	0.49502	2.99998
62	3.7493	0.4945	2.99984
62.5	3.79785	0.49356	2.99969
63	3.8465	0.49219	2.99954
63.5	3.89556	0.49062	2.99938
64	3.94441	0.48922	2.99923
64.5	3.99288	0.48825	2.99907
65	4.04097	0.48768	2.99891
65.5	4.089	0.48734	2.99875
66	4.13707	0.48704	2.99858
66.5	4.18597	0.48675	2.99841
67	4.23521	0.48654	2.99824
67.5	4.2845	0.48646	2.99807
68	4.33371	0.48648	2.99789
68.5	4.38278	0.48662	2.99771
69	4.43166	0.48695	2.99753
69.5	4.4803	0.48754	2.99735
70	4.52919	0.48828	2.99716
70.5	4.57814	0.48894	2.99697
71	4.62688	0.48937	2.99678
71.5	4.67599	0.48959	2.99659
72	4.72508	0.48975	2.99639
72.5	4.77422	0.49002	2.99619
73	4.82344	0.49058	2.99599
73.5	4.87267	0.4916	2.99579
74	4.92179	0.49311	2.99558
74.5	4.97106	0.49503	2.99538
75	5.0204	0.49722	2.99516
75.5	5.06973	0.49959	2.99495
76	5.11884	0.50207	2.99473
76.5	5.16835	0.50469	2.99452
77	5.21754	0.5074	2.9943
77.5	5.26629	0.51008	2.99407

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (µV/mW)
78	5.31514	0.51256	2.99385
78.5	5.36411	0.51477	2.99362
79	5.41303	0.51689	2.99339
79.5	5.46253	0.51919	2.99315
80	5.51242	0.52176	2.99292
80.5	5.56221	0.52462	2.99268
81	5.61219	0.5277	2.99244
81.5	5.6621	0.53077	2.9922
82	5.71196	0.53368	2.99195
82.5	5.7623	0.53648	2.9917
83	5.81226	0.5392	2.99145
83.5	5.8627	0.54175	2.9912
84	5.91286	0.54384	2.99094
84.5	5.96272	0.54524	2.99069
85	6.01252	0.54583	2.99043
85.5	6.06186	0.54547	2.99016
86	6.11141	0.544	2.9899
86.5	6.16115	0.54118	2.98963
87	6.21128	0.53676	2.98936
87.5	6.26172	0.53051	2.98909
88	6.31228	0.52217	2.98882
88.5	6.36256	0.51147	2.98854
89	6.41262	0.49817	2.98826
89.5	6.46222	0.48225	2.98798
90	6.51211	0.46369	2.98769
90.5	6.56211	0.44321	2.98741
91	6.6125	0.42198	2.98712
91.5	6.66327	0.40157	2.98683
92	6.71324	0.38381	2.98653
92.5	6.76286	0.36922	2.98624
93	6.81242	0.3579	2.98594
93.5	6.86218	0.34968	2.98564
94	6.91214	0.34424	2.98533
94.5	6.96263	0.34111	2.98503
95	7.01268	0.33983	2.98472
95.5	7.06244	0.34002	2.98441
96	7.11241	0.34149	2.9841
96.5	7.16211	0.34415	2.98378
97	7.2114	0.34788	2.98347
97.5	7.26059	0.35265	2.98315
98	7.30977	0.35846	2.98282
98.5	7.35909	0.36532	2.9825
99	7.40906	0.37324	2.98217
99.5	7.45945	0.3821	2.98184

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
100	7.5108	0.39185	2.98151
100.5	7.56225	0.40223	2.98118
101	7.61286	0.41301	2.98084
101.5	7.6638	0.42439	2.98051
102	7.71408	0.43603	2.98016
102.5	7.76368	0.44775	2.97982
103	7.81344	0.45965	2.97948
103.5	7.86364	0.47177	2.97913
104	7.9142	0.48419	2.97878
104.5	7.96479	0.49693	2.97843
105	8.01572	0.51015	2.97807
105.5	8.06594	0.52367	2.97772
106	8.11592	0.53782	2.97736
106.5	8.16568	0.55291	2.977
107	8.21585	0.56949	2.97663
107.5	8.26616	0.58777	2.97627
108	8.31649	0.60781	2.9759
108.5	8.36681	0.62973	2.97553
109	8.41704	0.6536	2.97515
109.5	8.46725	0.67962	2.97478
110	8.51746	0.70803	2.9744
110.5	8.56798	0.73937	2.97402
111	8.61892	0.7742	2.97364
111.5	8.66964	0.81231	2.97326
112	8.72083	0.85411	2.97287
112.5	8.77221	0.8987	2.97248
113	8.82311	0.9438	2.97209
113.5	8.87331	0.98664	2.9717
114	8.92344	1.025	2.9713
114.5	8.97349	1.05654	2.97091
115	9.02363	1.07967	2.97051
115.5	9.07419	1.09298	2.9701
116	9.1251	1.09411	2.9697
116.5	9.17562	1.08003	2.96929
117	9.22614	1.04748	2.96889
117.5	9.27668	0.9945	2.96848
118	9.32679	0.9233	2.96806
118.5	9.37693	0.83946	2.96765
119	9.42737	0.75171	2.96723
119.5	9.47739	0.67041	2.96681
120	9.52725	0.6009	2.96639
120.5	9.57702	0.54492	2.96596
121	9.62712	0.50119	2.96554
121.5	9.67687	0.46815	2.96511

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
122	9.72656	0.44328	2.96468
122.5	9.77684	0.4246	2.96425
123	9.82676	0.41105	2.96381
123.5	9.87679	0.40124	2.96337
124	9.92682	0.39412	2.96294
124.5	9.97697	0.38875	2.96249
125	10.02688	0.38458	2.96205
125.5	10.07716	0.38129	2.96161
126	10.12752	0.37882	2.96116
126.5	10.17763	0.37715	2.96071
127	10.22771	0.37604	2.96026
127.5	10.27828	0.37522	2.9598
128	10.32862	0.37452	2.95934
128.5	10.3792	0.3739	2.95889
129	10.43012	0.37331	2.95843
129.5	10.48103	0.3727	2.95796
130	10.53212	0.3721	2.9575
130.5	10.58237	0.37171	2.95703
131	10.63247	0.37165	2.95656
131.5	10.6828	0.37184	2.95609
132	10.73313	0.3721	2.95562
132.5	10.78389	0.37222	2.95514
133	10.83504	0.37208	2.95466
133.5	10.8859	0.37173	2.95418
134	10.93684	0.37136	2.9537
134.5	10.98789	0.3712	2.95322
135	11.03833	0.37136	2.95273
135.5	11.08867	0.37177	2.95224
136	11.1389	0.37223	2.95175
136.5	11.18886	0.37248	2.95126
137	11.23828	0.37242	2.95077
137.5	11.28819	0.37205	2.95027
138	11.33831	0.37148	2.94977
138.5	11.38842	0.37083	2.94927
139	11.43847	0.37032	2.94877
139.5	11.48878	0.37013	2.94827
140	11.53885	0.37043	2.94776
140.5	11.58899	0.37124	2.94725
141	11.63908	0.37238	2.94674
141.5	11.68983	0.37349	2.94623
142	11.74066	0.37422	2.94571
142.5	11.79165	0.3745	2.94519
143	11.84268	0.37455	2.94468
143.5	11.89356	0.37469	2.94415

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
144	11.94432	0.37498	2.94363
144.5	11.99482	0.37531	2.94311
145	12.04452	0.3756	2.94258
145.5	12.09419	0.3759	2.94205
146	12.14416	0.37633	2.94152
146.5	12.1943	0.37695	2.94099
147	12.2443	0.37769	2.94045
147.5	12.29417	0.37833	2.93991
148	12.34443	0.37875	2.93937
148.5	12.39456	0.37897	2.93883
149	12.44522	0.37908	2.93829
149.5	12.49591	0.37913	2.93775
150	12.54687	0.37918	2.9372
150.5	12.59803	0.37927	2.93665
151	12.64866	0.37944	2.9361
151.5	12.69865	0.3797	2.93555
152	12.74915	0.37996	2.93499
152.5	12.79952	0.38012	2.93443
153	12.85027	0.38022	2.93388
153.5	12.90149	0.38056	2.93331
154	12.95217	0.3814	2.93275
154.5	13.00227	0.38271	2.93219
155	13.05215	0.38412	2.93162
155.5	13.10181	0.38522	2.93105
156	13.15183	0.38584	2.93048
156.5	13.20234	0.38603	2.92991
157	13.25327	0.38596	2.92933
157.5	13.30385	0.38591	2.92876
158	13.35451	0.38603	2.92818
158.5	13.40539	0.38631	2.9276
159	13.4561	0.3866	2.92702
159.5	13.50727	0.3868	2.92643
160	13.55772	0.38695	2.92585
160.5	13.60824	0.38708	2.92526
161	13.659	0.38715	2.92467
161.5	13.70932	0.38712	2.92408
162	13.75956	0.38694	2.92349
162.5	13.81062	0.38661	2.92289
163	13.86148	0.38632	2.92229
163.5	13.91265	0.38629	2.92169
164	13.96311	0.38654	2.92109
164.5	14.01308	0.38687	2.92049
165	14.06296	0.38703	2.91988
165.5	14.11324	0.38685	2.91928

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
166	14.16328	0.38631	2.91867
166.5	14.21403	0.38563	2.91806
167	14.26455	0.38523	2.91745
167.5	14.31497	0.38541	2.91683
168	14.36475	0.38605	2.91622
168.5	14.41459	0.38669	2.9156
169	14.46492	0.38696	2.91498
169.5	14.51511	0.38699	2.91436
170	14.56481	0.3872	2.91373
170.5	14.61436	0.38784	2.91311
171	14.66402	0.38881	2.91248
171.5	14.71388	0.3898	2.91185
172	14.76383	0.39047	2.91122
172.5	14.81433	0.39074	2.91059
173	14.8654	0.39082	2.90996
173.5	14.91603	0.391	2.90932
174	14.96617	0.39122	2.90868
174.5	15.01656	0.39119	2.90804
175	15.06708	0.39083	2.9074
175.5	15.11769	0.39046	2.90676
176	15.16844	0.3905	2.90611
176.5	15.2185	0.39102	2.90547
177	15.26871	0.39176	2.90482
177.5	15.31865	0.3924	2.90417
178	15.36849	0.39279	2.90351
178.5	15.41813	0.39294	2.90286
179	15.46813	0.39293	2.9022
179.5	15.51859	0.39286	2.90155
180	15.56942	0.39288	2.90089
180.5	15.61924	0.39309	2.90023
181	15.66912	0.39346	2.89956
181.5	15.71895	0.39389	2.8989
182	15.76851	0.3943	2.89823
182.5	15.81737	0.39474	2.89756
183	15.86754	0.39534	2.89689
183.5	15.91771	0.39617	2.89622
184	15.9677	0.39718	2.89555
184.5	16.01745	0.39826	2.89488
185	16.06783	0.39928	2.8942
185.5	16.11841	0.40003	2.89352
186	16.16888	0.40046	2.89284
186.5	16.21896	0.40069	2.89216
187	16.2691	0.40083	2.89147
187.5	16.31927	0.40093	2.89079

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
188	16.36958	0.40096	2.8901
188.5	16.41932	0.40087	2.88941
189	16.46991	0.40068	2.88872
189.5	16.52015	0.40045	2.88803
190	16.57072	0.40028	2.88734
190.5	16.62007	0.40027	2.88664
191	16.67023	0.40046	2.88594
191.5	16.72047	0.40086	2.88525
192	16.77124	0.40138	2.88455
192.5	16.82157	0.4019	2.88384
193	16.87234	0.4024	2.88314
193.5	16.92347	0.40279	2.88243
194	16.97499	0.40289	2.88173
194.5	17.02573	0.40265	2.88102
195	17.07721	0.40221	2.88031
195.5	17.12865	0.40183	2.8796
196	17.1797	0.40178	2.87888
196.5	17.2296	0.40208	2.87817
197	17.28002	0.40253	2.87745
197.5	17.33032	0.4029	2.87673
198	17.38058	0.40315	2.87601
198.5	17.43077	0.40342	2.87529
199	17.48126	0.40386	2.87456
199.5	17.53184	0.40457	2.87384
200	17.58259	0.40545	2.87311
200.5	17.6323	0.40633	2.87238
201	17.68271	0.40717	2.87165
201.5	17.73301	0.40794	2.87092
202	17.78346	0.40855	2.87019
202.5	17.83304	0.40898	2.86945
203	17.88335	0.40932	2.86872
203.5	17.93397	0.40966	2.86798
204	17.98474	0.4101	2.86724
204.5	18.03452	0.41075	2.8665
205	18.08516	0.41161	2.86576
205.5	18.13558	0.41235	2.86501
206	18.18554	0.41268	2.86427
206.5	18.23525	0.41256	2.86352
207	18.28528	0.41207	2.86277
207.5	18.33573	0.41126	2.86202
208	18.38629	0.41001	2.86127
208.5	18.43582	0.40833	2.86051
209	18.48586	0.40638	2.85976
209.5	18.53599	0.40437	2.859

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
210	18.58572	0.40239	2.85824
210.5	18.63488	0.40041	2.85748
211	18.68457	0.39823	2.85672
211.5	18.73433	0.39562	2.85596
212	18.78462	0.39239	2.85519
212.5	18.83445	0.38865	2.85443
213	18.8847	0.38456	2.85366
213.5	18.93538	0.38027	2.85289
214	18.98593	0.3758	2.85212
214.5	19.03563	0.37109	2.85135
215	19.08573	0.36596	2.85058
215.5	19.13609	0.36045	2.8498
216	19.18689	0.35462	2.84902
216.5	19.23676	0.34872	2.84825
217	19.28747	0.34273	2.84747
217.5	19.33856	0.33698	2.84669
218	19.38927	0.33185	2.8459
218.5	19.43934	0.32743	2.84512
219	19.48989	0.32353	2.84433
219.5	19.54064	0.31998	2.84355
220	19.59146	0.31664	2.84276
220.5	19.6414	0.31363	2.84197
221	19.69204	0.31101	2.84118
221.5	19.74297	0.30888	2.84038
222	19.79428	0.30741	2.83959
222.5	19.84507	0.30707	2.83879
223	19.89644	0.30839	2.838
223.5	19.94729	0.31148	2.8372
224	19.9981	0.31607	2.8364
224.5	20.0479	0.32163	2.8356
225	20.09822	0.32802	2.83479
225.5	20.14882	0.33499	2.83399
226	20.19964	0.34239	2.83318
226.5	20.24949	0.34992	2.83238
227	20.29976	0.35765	2.83157
227.5	20.35	0.36539	2.83076
228	20.40025	0.37299	2.82995
228.5	20.44976	0.3802	2.82913
229	20.50048	0.38715	2.82832
229.5	20.55126	0.39365	2.8275
230	20.60201	0.39973	2.82669
230.5	20.65195	0.40526	2.82587
231	20.70239	0.41026	2.82505
231.5	20.75252	0.41452	2.82423

Temperature (°C)	Time (min)	DSC (mW/mg)	Sensitivity (μV/mW)
232	20.80262	0.41823	2.8234
232.5	20.85179	0.42161	2.82258
233	20.90164	0.42501	2.82175
233.5	20.95134	0.42832	2.82093
234	21.00105	0.43136	2.8201
234.5	21.05002	0.43386	2.81927
235	21.09988	0.43574	2.81844
235.5	21.15002	0.43709	2.81761
236	21.20005	0.43818	2.81677
236.5	21.24998	0.4392	2.81594
237	21.3008	0.44019	2.8151
237.5	21.3515	0.44112	2.81427
238	21.40227	0.44207	2.81343
238.5	21.45296	0.44308	2.81259
239	21.50387	0.44406	2.81174
239.5	21.55516	0.44495	2.8109
240	21.60547	0.44576	2.81006

CURRICULUM VITAE

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PUBLICATION	Chuenkaek, N. and Pimsamarn, J., 2014, "Preparation of Thermoplastic Mask from Polymer Blend of Polybutylene Succinate and Ethylene Vinyl Acetate for Radiotherapy Application", The 24th Thai Institute of Chemical Engineering and Applied Chemistry Conference, December 18-19, 2014, Furama Hotel, Chiang Mai, Thailand.