UTILIZATION OF VARIOUS FILLERS FOR RUBBER MAT DEVELOPMENT

INTRODUCTION

In general, fillers are known as ingredient added in rubber for several purposes such as to reinforce mechanical properties of rubber, to make characteristic properties of rubber compound to be more practical, or to minimize the cost etc. Industrial fillers can be classified into 2 major groups, according to their efficiency, as reinforcing fillers and non-reinforcing fillers (inert fillers). They can be also classified according to their color into 2 groups; carbon black and light-color fillers.

Although fillers such as $CaCO_3$, talcum, clay and rice husk ash (RHA), etc. have been used as rubber-filler, not much work was found in the literature related to the use of natural zeolite as filler. Zeolite (natural or synthetic zeolite) can be considered as another alternative for using as rubber-filler. Natural zeolite, clay forming from volcanic ash, is the volcanic mineral that has special characteristic. As its chemical structure, it is categorized as hydrated aluminosilicate including hydrogen, oxygen, aluminum, and silicon. Zeolite forms like interconnecting lattice structure (Ming and Mumpton, 1995). The formation of itself causes character honeycomb framework alike, which has a variety of size depending on type of zeolite. Due to special characteristic, zeolite differs from other aluminosilicates (e.g. kaolin, etc.) by having interesting physical and chemical properties such as ion exchange capacity, adsorption and related molecular sieve properties, dehydration/rehydration potential, catalytic properties, etc.

The above mentioned properties are primary properties which make zeolite as widely used in industry, agriculture, and environment fields. In addition, from physical properties of zeolite (such as light color, specific gravity etc.), zeolite is suitable for construction, paper industry, rubber etc. It is to say the significant utilizations of zeolite are odor control, industrial absorbents, industrial fillers, gas

adsorption, soil remediation, wastewater filtration, flocculating agent, animal feeds, hydroponics, molecular sieves, catalysts, desiccants, lightweight concrete, etc.

From global consumption of zeolite in 2000 (Perdana, n.d.), there are almost 4 million of natural zeolite usages. However, natural zeolite was used in industries that not use high technology such as construction, shoe deodorization. It was also used as deodorant and absorbent in farm and refrigerator. In contrast, synthetic zeolite, which has high purity and certain pore size, is demanded from the market especially detergent and petrochemical industries. In Asia-Pacific (except Japan), there is approximately 160,000 tons of synthetic zeolite requirement. The main countries are Korea (85,000 tons/yr), Thai (40,000 tons/yr), China (13,000 tons/yr), and India (12,000 tons/yr). In 2004, the amount of synthetic zeolite increased from 1.3 million tons (2000) to 1.8 million tons, while the amount of natural zeolite decreased from 3.9 million tons (2000) to 2.5 millions tons (Lauriente and Inoguchi, n.d.). The countries in Asia (except Japan) are the area plentifully using natural zeolite, mostly in construction industry (as cement additives).

Lower demand of natural zeolite can be explained by natural zeolite itself has limits of purity (large variation in mineral composition), crystal size, porosity, and pore diameter. As a result of the purity limitation, natural zeolite is not popular in the industries which require high purity such as catalyst. Nevertheless, the high purity natural zeolite of course has high price too.

In Thailand 90 % of dairy cow farms are kept in loose housing systems (Tudsri and Sawasdipanit, 1998), which are often concrete floor. Floor types of housing are important factor that affect on cow comfort. Cows do not like to stand to be mounted when kept on concrete floor and they prefered softer floor such as grassland, land or land covered by straw (Diskin and Sreenan, 2000). Mounting behavior of estrus cow decreased a half time when they kept on concrete floor in comparison with when they kept on land. While period of estrus behavior decreased approximately 25 % (Britt *et al.*, 1986). As weather of Thailand, it was found that the expression of estrous behavior was influenced from floor types than seasons (Rodtian

et al., 1996). In conclusion, floor type has an impact on estrus behavior expression of the cows during induced estrus. The dairy cows kept on rubber mat floor in loosing pen showed clearer and easier to detect sign of estrus behavior than those kept on concrete floor in similar type of housing system.

It can be seen that although several extensive works, as mentioned above, have been carried out to study several applications of natural zeolite, but the effect of natural zeolite on the mechanical properties and fluid and heat aging resistance of the vulcanizates remains quite inadequate. It is therefore the aim of this thesis to elucidate the effect of vulcanization system on mechanical properties of rubber compound. Conventional vulcanization (CV) and efficient vulcanization (EV) were compared with those of rubber mat's formulation (control) obtained from the industry. The other objective is to study the influence of natural zeolite, especially the low purity with low price, as filler on the mechanical properties (e.g. hardness, tear strength, compression set and abrasion) and fluid and heat aging resistance of rubber mat compared with those filling with conventional filler ($CaCO_3$ and Rice Hush Ash) to propose the natural zeolite as alternative filler in the rubber industry.