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Effect of KOH as Stabilizer on Mechanical and Chemical Properties of Liquid Rubber Compound

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The effect of KOH stabilizer on mechanical and chemical properties of liquid rubber compound has been examined. Liquid rubber made by mixing stearic acid and zinc oxide as activator, 3,5-di-*tert*-butyl-4-hydroxy toluene and liquid smoke as antioxidant, $CaCO_3$ as filler, dibenzothiazole disulfide and tetramethyl thiuram disulfide as accelerator, KOH as stabilizer and sulphur as vulcanizing agent with concentrated latex at room temperature, then maturated for 72 h. In this research the use of KOH stabilizer was varied as 3, 4, 5, 6 and 7 phr. Before being examined, rubber film made from liquid rubber compound by dyeing process then vulcanization done at 100 °C with water vapor. The rubber film which produced from liquid rubber compound then was characterized their mechanical and chemical properties such as resistance to heating, resistance to acid and alkaline resistance. The result showed that KOH content changed the mechanical and chemical properties of liquid rubber compound.

Keywords: Liquid rubber compound, Stabilizer, Vulcanization, Tensile strength.

INTRODUCTION

Liquid rubber compound is a mixture of natural rubber latex with various chemical additives to obtain the final result of vulcanizates with a particular process[1,2]. In the manufacture of rubber goods, liquid rubber is the result before the end of the process to obtain the finished rubber goods. In the process of making liquid rubber or compounding, chemical reaction will occur between polyisoprene of latex rubber with a variety of chemicals that are used to form the three-dimensional cross-linking between the molecules of the rubber material polyisoprene with vulcanizator such as sulphur that will improve nature of the original rubber to be more usable for manufacture rubber goods[3-6]. Liquid rubber compound chemicals generally consists of vulcanizator, accelerator, antioxidant ingredients, activator, stabilizer and filler as well as other supplemental materials[1,2]. Latex rubber finished products generally have certain traits preferred, therefore, liquid rubber composition to be made tailored to the type of product to be produced or the nature of the preferred.

The raw material of liquid rubber compound is concentrated latex with most additive components solid so that the process of mixing or compounding would be more perfect if it is done by mixing various ingredients such additives in the liquid state is by first dispersing the various ingredients into liquid ingredients with the addition of certain dispersants so expect the resulting liquid rubber specification will be eligible to make a variety of rubber goods[1,7].

The problems that exist in the rubber industry is the unavailability of liquid or compound in large quantities ready to be used to make a variety of rubber goods as new liquid rubber is usually made prior to manufacture certain goods carried, in addition to compound usually made in the form of a dense mix of rubber material that has been frozen, then solid compound is dissolved if it will be made into a particular item[2].

The purpose of this research is to study the effect of variation in the use of KOH as stabilizer in the manufacturing process of liquid rubber compound on their changes of the mechanical and chemical properties which includes the resistance to heating or oxidation, resistance to acid and resistance to alkaline. Determination the changes of mechanical and chemical properties done by measuring the tensile strength and elongation at break of rubber films before and after a particular treatment[4,8-10].

EXPERIMENTAL

The process of making liquid rubber or rubber compound is the process of mixing the concentrated latex materials with different dispersion additives that have been made in advance. such as stearic acid and zinc oxide as activator, 3,5-di-tertbutyl-

4-hydroxy toluene (BHT) and liquid smoke as antioxidant, $CaCO_3$ as filler, dibenzothiazole disulfide (MBTS) and tetramethyl thiuram disulfide (TMTD) as accelerator, KOH as stabilizer and sulphur as vulcanizing agent[1,2-5,11,13]. The addition of chemicals do one at a time, stirring until homogeneous materials recently added next. After all the additive is added, the liquid rubber is then allowed to stand for 72 h at room temperature for curing. Variation in this study to be carried out is the use of KOH as a stabilizer. The variation of the concentration of KOH to be done is 3, 4, 5, 6 and 7 pH. To determine the quality of liquid rubber compound that produced, the first time made rubber film by means of dyeing, drying and vulcanization by heating in water vapor in order to obtain a rubber film with a thickness of from 0.07 to 0.11 mm in accordance with ASTM D-412 standard[11-16]. Further testing of the mechanical and chemical properties of rubber films include the resistance of heating, the resistance of acid and the resistance of alkaline[1,9,10,12,17]. All of these activities are done in the laboratory of Plastics and Rubber Research Facility, Center for Leather, Rubber and Plastics Yogyakarta and in the Laboratory of Chemistry Faculty of Mathematics and Natural Sciences, Gadjah Mada University, Yogyakarta.

RESULTS AND DISCUSSION

Rubber film: Tests performed with a liquid rubber compound first made rubber film by immersion followed by vulcanization at 100 °C by using a water vapor[14]. As an example of the resulting rubber film is presented in Fig. 1.

Fig. 1. Rubber film

Thermal resistance: The higher the concentration of KOH used rubber tensile strength films before and after heating is greater (Fig. 2), this suggests that the more perfect the vulcanization process in which more and more use of KOH so that the strength of the rubber produced films are also getting bigger. From this figure it is clear that an increase in tensile strength before and after heating on the use of KOH greater, it indicates that the rubber film more resistant to heating. This situation is caused by the KOH concentration is greater then the pH of the liquid rubber will be greater so that the process of coagulation that occurs will be less and less. It will cause the vulcanization reaction between polyisoprene with sulphur more perfect, so that the number of crosslinks formed are also more and more.

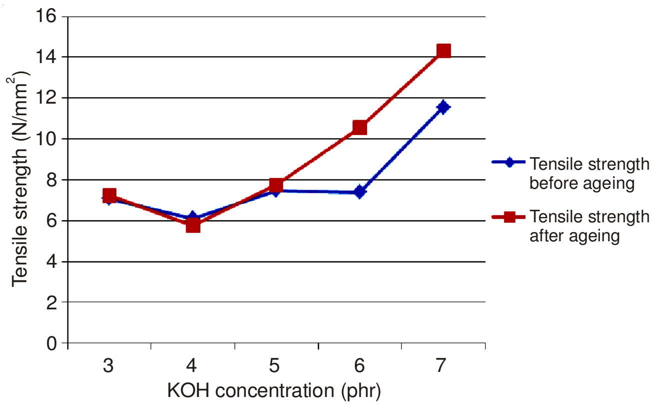

Fig. 2. Tensile strength changes before and after ageing at various KOH content

As well as the tensile strength, elongation at break values of rubber films tend to be greater on the use of KOH concentration is greater, it demonstrates the power of rubber film to be greater (Fig. 3). This situation is due to the higher concentration of KOH vulcanization reaction would then be perfect, so the amount of crosslinking that occurs between polyisoprene with sulphur will be many more. In this figure also shows that the decline in the value of elongation at break before and after heating at all levels of KOH used. The decrease in elongation at break value is the less visible on the growing use of KOH and reached a minimum at 6 phr of KOH concentration and relatively stable at the higher levels of KOH, it indicates that the vulcanization process that began optimum on the use of 6 phr KOH.

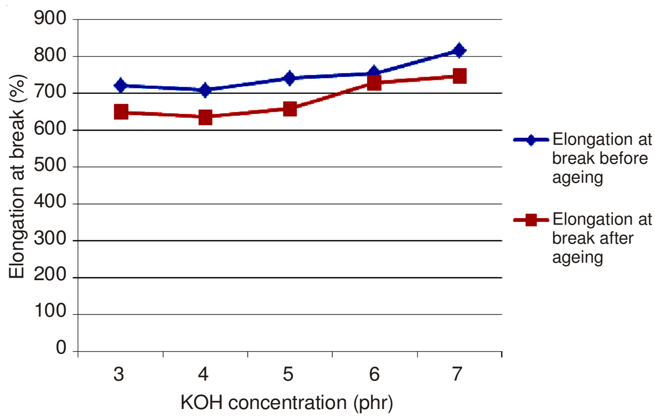

Fig. 3. Elongation at break changes before and after ageing at various KOH content

Acid resistance: The higher levels of KOH is used, the value of tensile strength rubber produced films tend to increase (Fig. 4), both before and after immersion in acid, it demonstrates the power of an increasingly large rubber film. This situation is due to the more perfect the vulcanization process that the greater use of KOH so that the number of crosslinks between polyisoprene with sulphur to form more and more. From this figure it is clear that an increase in tensile strength before and after heating at all levels of KOH is used, it indicates that the use of KOH as a stabilizer causes the rubber made more resistant to acid.

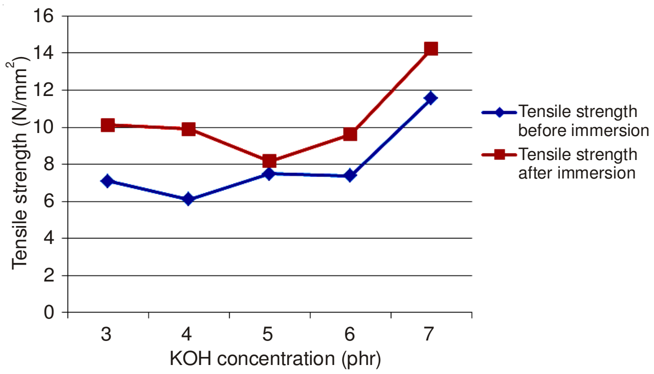

Fig. 4. Tensile strength changes before and after immersion in acid at various KOH content

As well as tensile strength, elongation at break of the rubber film tends to be greater at the greater use of KOH (Fig. 5), it shows the strength of the rubber films are getting higher. This situation is caused by the greater use of KOH the vulcanization process that occurs will be perfect so that the amount of crosslinking that will happen more and more. This figure shows the increases values of elongation at break at various levels of KOH used, it indicates that the use of KOH as stabilizer causes the rubber films more resistant to acid. This figure also shows that the increase in the values of elongation at break after immersion smallest occurred in the use of KOH concentration of 7 phr, it has been demonstrated that the process of vulcanization optimum use of the KOH concentration.

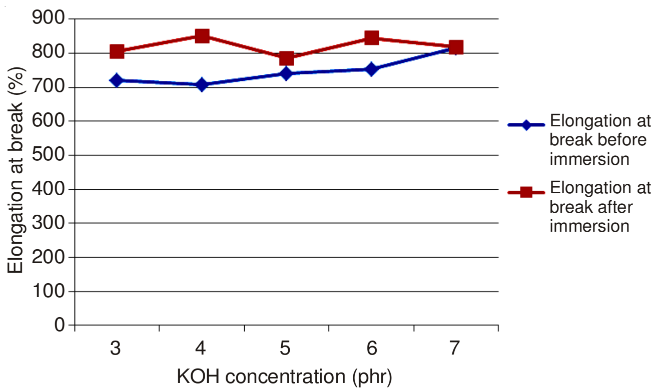

Fig. 5. Elongation at break changes before and after immersion in acid at various KOH content

Alkaline resistance: The higher levels of KOH is used, it turns tensile strength of rubber films made also getting bigger (Fig. 6), it indicates that the rubber film has greater strength. The situation is caused by the higher levels of KOH used the rubber compound that is made more stable so that the vulcanization process that occurs will be perfect so that the number of crosslinks between polyisoprene with sulphur formed is to be more. In the picture is also seen that an increase in tensile strength rubber film before and after immersion in alkaline KOH at all levels are used, this indicates that the rubber film made more resistant to alkaline. This situation is caused by immersion in alkaline atmosphere will cause more alkaline so the vulcanization process that occurs even more perfect.

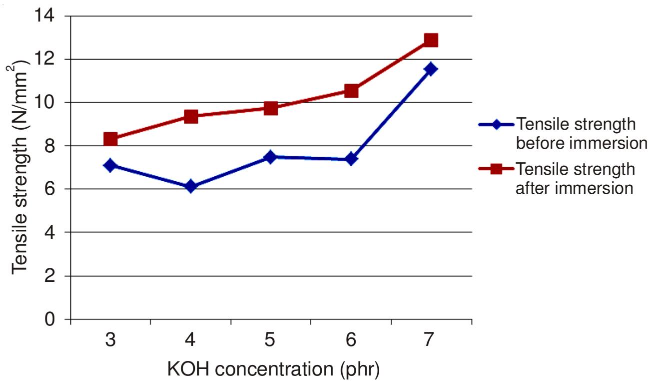

Fig. 6. Break strength changes before and after immersion in alkaline at various KOH content

As well as tensile strength, elongation at break of the rubber film turned out to be made, experienced a significant increase in the use of KOH concentration is greater(Fig. 7), it demonstrates the strength of the rubber films are getting bigger. This situation is caused by the process of vulcanization is more perfect in the use of KOH greater. In the figure it showed an increase in elongation at break before and after immersion in alkaline, on all levels of KOH is used, it indicates that the rubber film produced increasingly resistant to alkaline. This figure also shows that the increase in the value of the smaller elongation at break of the growing use of KOH and the smallest increase occurred in the use of KOH content of 7 phr. This situation shows that the more perfect the vulcanization process and optimum values occurred in the use of KOH concentration of 7 phr.

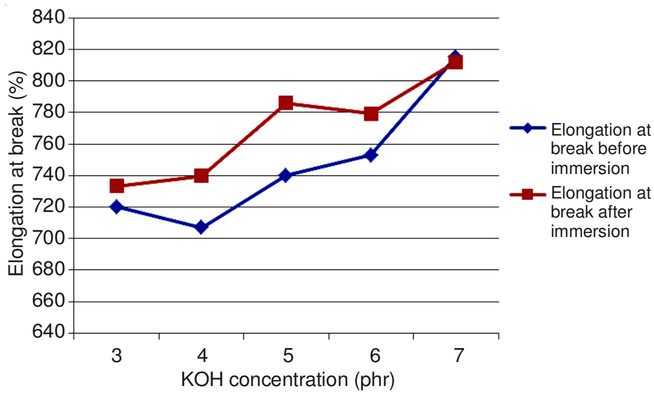

Fig. 7. Elongation at break changes before and after immersion in alkaline at various KOH content

Conclusion

The use of vulcanization time and KOH stabilizer variation changed the mechanical and chemical properties of liquid rubber compound produced. The best condition was the use of 45 min vulcanization time and 7 phr KOH concentration. The mechanical properties of liquid rubber compound as rubber film produced in this condition are tensile strength after aging as high as 14.31 N/mm^2, elongation at break after ageing as high as 746.46 %.

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