THE EFFECT OF PARAFFIN WAX TO PROPERTIES OF RADIATION VULCANIZATION NATURAL RUBBER LATEX (RVNRL)

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ABSTRACT

Dipping factories often encounter a serious problem with high tackiness of the finish products during storage. The tackiness effect can be lead to rejection of products. This tackiness effect of natural (NR) rubber film originates in the free rubber chain ends at the surface of the film. The tackiness is not depends on the degree of crosslinking (vulcanization), since radiation itself unable to reduce the tackiness effect. The RVNRL requires addition of additive or anti-tack agent into formulation to reduce tackiness effect. In this experiment, paraffin wax manufactured by Emulco Sdn Bhd under the tradename Aquawax 48 was added into RVNRL formulation as anti-tack and the effect of paraffin wax to physical and mechanical properties of RVNRL was study.

Introduction

Generally, there are several of compounding ingredients added into latex formulation such as fillers, pigments, surface active agents and also viscosity modifiers to achieve requirement needed. Tackiness is effects that can able leading to big problem to end product of rubber. The effect from tackiness tends to damage rubber product in packaging. Aquawax 48 produce by Emulco Sdn Bhd is a paraffin wax emulsion which act as anti-tack agent to reduce tackiness and also extend product life. Generally, paraffin wax is a white or colorless soft solid derivable from petroleum,coal or oil shale that consists of a mixture of hydrocarbon molecules containing between twenty and forty carbon atoms. Paraffin is used synonymously with alkane, indicating hydrocarbon with the general formula C_nH_{2n+2}. Paraffin wax mostly found as a white, odorless, tasteless, waxy solid with typical melting point between 46 to 68^{o}C.

Aquawax 48 is a paraffin wax emulsion blended especially for the rubber industries to reduce tackiness and to extend product life. Although the presence of ozone only represents a low concentration in the atmosphere, it is universally recognized as a major contributor to the degradation of rubber products. Wax Emulsion can impart to the anti-degrading of latex rubber. Wax emulsion particle added into rubber act by migrating to the rubber surface during curing and drying process from emulsion, where they form a thin layer on surface of rubber which act as a barrier against ozone and as anti-tack agent.

In general the uses of waxes are traditionally to improve pr obtain certain suface properties of coatings like wood stains,printing inks, lacquers and overprint varnishes is well known. Important examples of such properties are the abrasion resistance, the wet rub resistance as well as the mar and scuff resistance, gloss/matting, and water repellence.

Aquawax 48 is a water based wax emulsion in the form of a white emulsion which disperses easily in water at working temperatures. It is anionic in nature and developed especially to provide a maximum compatibility with other stabilizer and additives in compound. Besides act as anti-tack agent, aquawax 48 able to act as as anti-blooming and anti-ozone which can longer the shelf life of rubber product.

The typical properties of Aquawax 48 are state as below;

1. Off white colour emulsion
2. 50% Solid Content
3. 0.95g/cm^3 density
4. pH at 9.25
5. Viscosity around 400mPa.s
6. Particle Size 1µm
7. 6 months shelf life

Objective of Study

1. To study the effect of paraffin wax (Aquawax 48) on physical properties of RVNRL.
2. To study the effect of paraffin wax (Aquawax 48) on mechanical properties of RVNRL.
3. To study the optimum part per hundred rubber of paraffin wax into RVNRL.

Experimental

Chemical

The latex used in this experiment was High Ammonia concentrated latex produced by Getahindus (M) Sdn Bhd. The ammonia solution produced by Hartakimia Sdn Bhd, HDDA produced by BASF Malaysia Sdn Bhd, Paraffin Wax under trade name Aquawax 48 was produced by Emulco Sdn Bhd, Potassium Laurate and antioxidation agent undertrade name Aquanox LP produced by Aquaspersion Sdn Bhd.

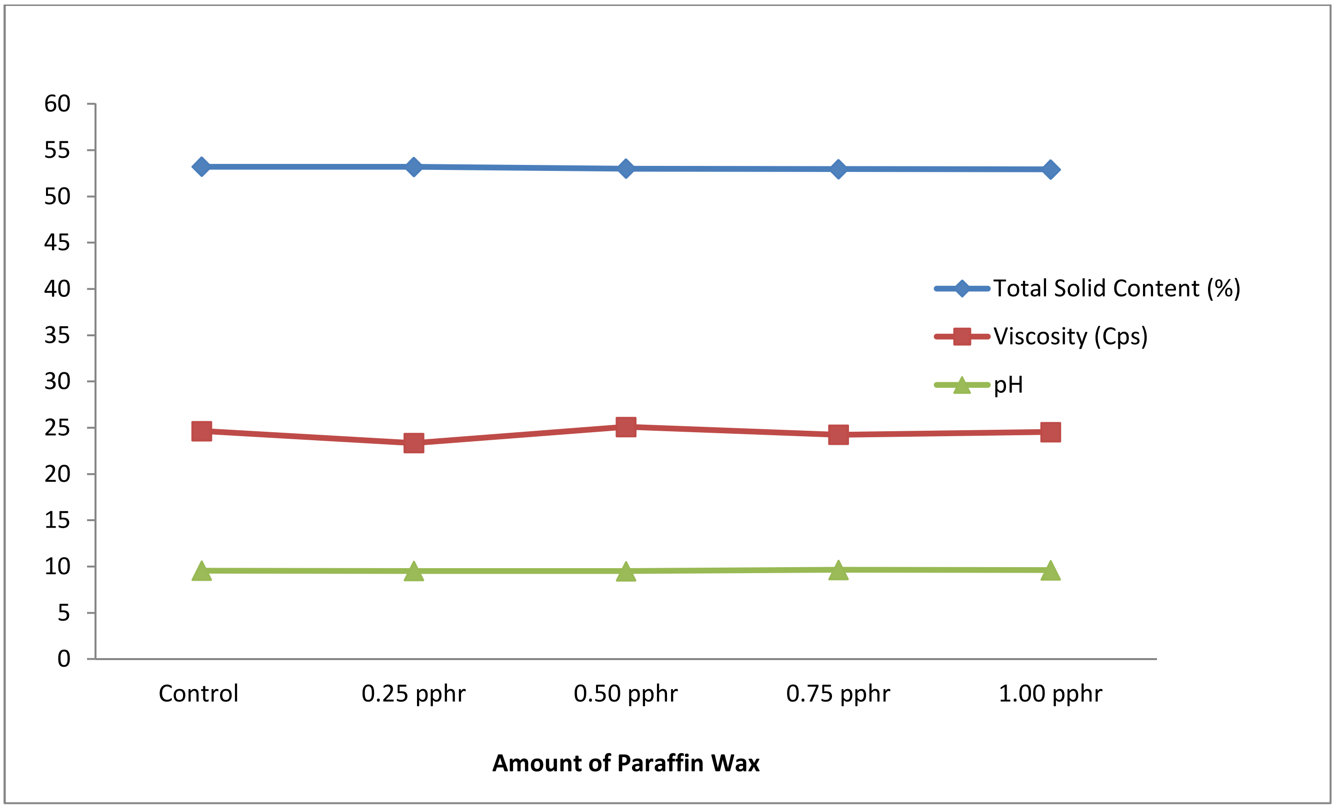
RVNRL Preparation

In this experiment, 2.5 pphr of HDDA was prepared into emulsion form to ensure the HDDA able to disperse easily in latex. The emulsion process of HHDA was prepared by adding water (the amount of water based on 60% total solid content of HA latex dilute to 52%) and 0.06 pphr of Potassium Laurate into beaker and then using emulsifier machine the mixing was emulsify for 30 minutes. The HDDA emulsion was added into latex while stirring drop by drop using dropper to ensure the HDDA disperse homogenously and reduce the tendency of chemical shock which can destabilize the latex. The stirring process was continued for 2 hours after the HDDA emulsion fully finish added.

The irradiation of latex was carried out by exposed to gamma radiation to 12 KGy using RAYMINTEX plant facilities. After the irradiation process, 2.5 pphr of Aquanox LP anti-oxidant was added into irradiated latex and the stirring process continue for 8 hours. After that, the irradiated latex known as RVNRL was divided into 5 portion or samples for addition of paraffin wax at 0 pphr (control), 0.25 pphr, 0.5 pphr, 0.75 pphr and 1.00 pphr. The RVNRL was stirred for 3 hours.

The testing such as total solid content, viscosity, mechanical stability time and tensile (unaged and aged) was carried out for each sample.

Result and Discussion



Graph 1 show the TSC, Viscosity and pH at different pphr of Paraffin Wax

Total Solid Content (TSC)

The total solid content of latex is defined as the percentage by weight of the whole which is non-volatile at a definite temperature in an open atmosphere. From the tsc graph line shown that an increasing amount of paraffin wax decrease the tsc of the each sample. This is expected since the concentration of paraffin wax mixture is 50% and the concentrations of RVNRL 53.22% which mean addition of paraffin wax will increase amount of in RVNRL thus reduce the tsc of RVNRL samples. However, this is not be a problem since paraffin wax is non-volatile and will remain in rubber after drying process.

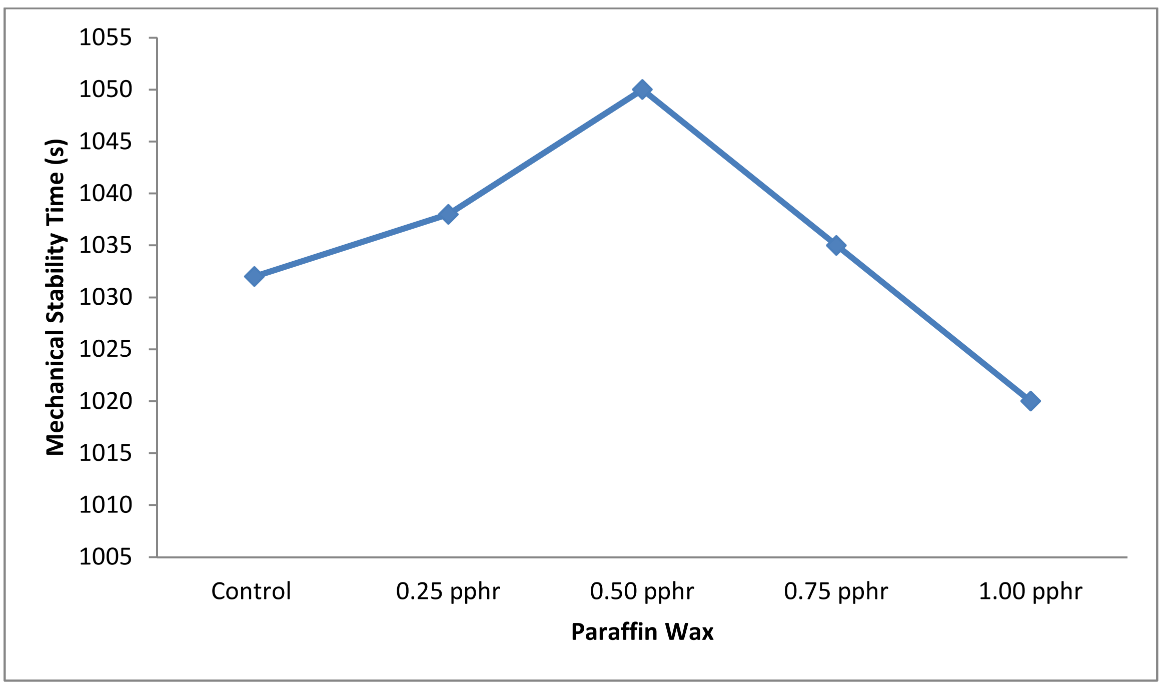
Viscosity

The viscosity test is a measure of its resistance to flow. From the graph 1, it show that the viscosity of the RVNRL sample decreases as the amount of paraffin wax increases. This is expected as water content in 50% paraffin wax contributes to reduce viscosity of RVNRL. Apart of that, the characteristic of paraffin wax which act like a soap when added in RVNRL by form a thin anionic barrier on surface of latex particle. This effect will reduce the resistance of latex to flow.

pH

pH is a numeric scale used to specify the acidity or alkalinity of an aqueous solution. The solution with a pH less than 7 is acidic and greater than 7 are alkaline or basic. Chemically, the ideal pH for latex is more than 7 to maintain in liquid form. Otherwise, the latex will coagulate when the pH less than 7. In this experiment, the pH of paraffin wax was 9 and addition of paraffin wax does not give great changes in pH of RVNRL even the amount of paraffin wax increased as shown in the graph. This indicates that paraffin wax will not coagulate the latex and suitable to use.

Mechanical stability Time

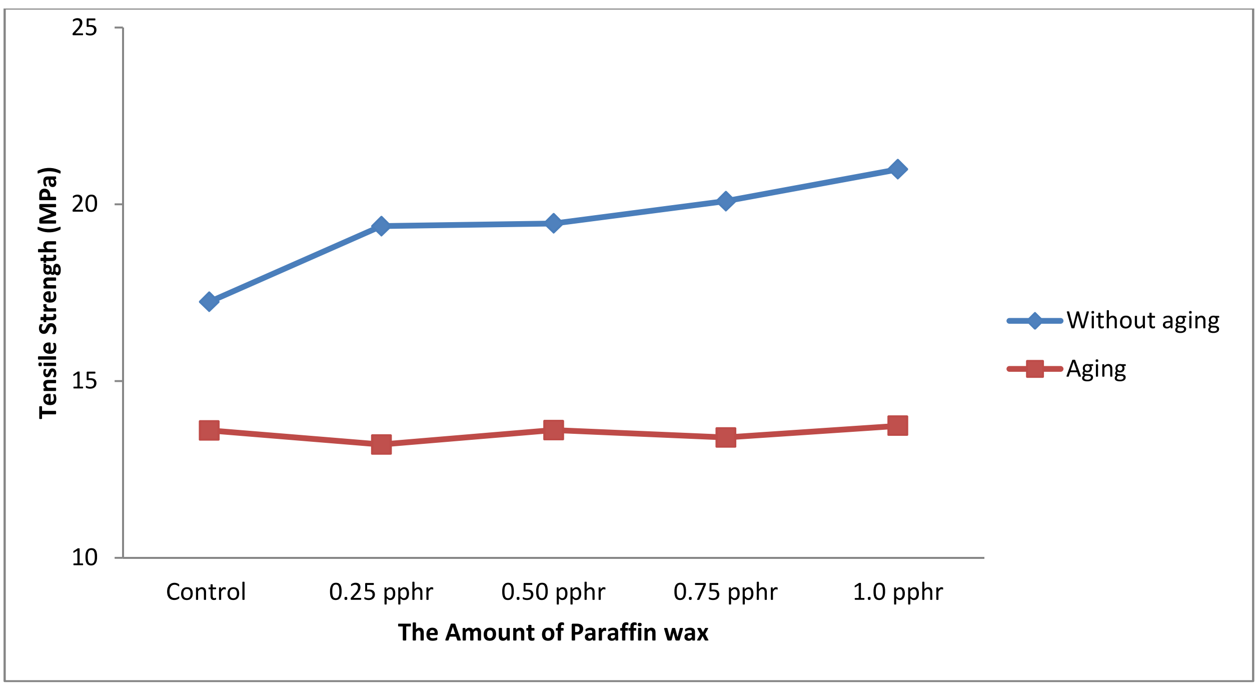


Graph 2 show the MST of RVNRL at different pphr of Paraffin Wax

Mechanical stability time of latex is meant its resistance time towards those mechanical influences which tend to increase the number and violence of collisions between particles and tend to coagulate the latex. The test carried out by stir a definite amount of RVNRL under given condition of dilution, temperature, speed of stirring and measure the time which elapses before signs of flocculation or pre-coagulation. The mechanical stability is expressed in seconds. In this experiment, the MST of RVNRL increased as the amount of paraffin wax increased however the MST drop drastically after the amount of paraffin wax at 0.50 pphr. This indicates that the optimum level of paraffin wax can be added should not more than 0.50 pphr and also show that mechanical stability of RVNRL very sensitive to paraffin wax which acts like an anionic soap even the different between samples only 0.25 pphr.

Tensile Strength

Tensile strength is the maximum stress that a material or in this experiment rubber dumbbell can withstand while being stretched or pulled before failing or breaking. The tensile strength is measured as force per cross-section area. In this experiment, the tensile strength was carried to samples without aging and aging. Aging samples are the rubber dumbbell which placed into oven at temperature 100^{0}C for 22 hours. The purpose of aging test is to predict the tensile strength for its shelf life by accelerating the heat at certain time. From the graph, the tensile strength of sample without aging increasing as the amount of paraffin wax increased. However, the tensile strength of sample with 1.00 pphr of paraffin wax still consider as low since the tensile strength only reach 20.99 MPa. Meanwhile, the tensile strength of control aging sample was drop to 13.60 MPa compare to control without aging at 17.24 MPa. However, the rise of paraffin wax into RVNRL improve the aging properties which shown in the graph that the range of sample maintain around 13.2 MPa to 13.8 MPa. This is expected due to the ability of paraffin wax migrate to the surface of rubber and form a thin and inert film which providing barrier against ozone attack and heat.



Conclusion

It is indicated that the addition of 0.5 pphr Paraffin Wax is the optimum amount that can be used in RVNRL formulation.

Reference

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2. High Polymer Latices: Their Science And technology D.C Blackley, Volume 1, Fundamental Principles