



## Utilize Natural Fiber: Treated Human Hair to Improve Rubber Physical Properties

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**Abstract** - The present study concerns the studies on the use of keratin waste, derived from Human Hair as short fiber for elastomer. The aim of this study is improve reinforcement of natural rubber by using treated Human Hair. Human hair is cheap material and it's give good strength. Human Hair is treated with Alum, Silane, and MMA. Treated human hair give better compatibility to rubber in rubber composite. Human hair has slow decomposition. Slow decomposition of hair improves service life of composite.. The composite is prepared by mixing the human hair and natural rubber in a two roll mill along with additives followed by vulcanization. This paper covers manufacturing and mechanical properties rubber and hair composite. Physical properties of natural rubber and hair composite are increase with increase compatibility of treated human hair and rubber.

**Keywords:** - treated Human hair, Natural rubber, Composite, Vulcanization, compatibility.

### I. INRODUCTION

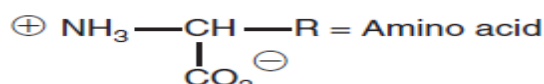
The interest in utilizing natural fibers as reinforcement in polymers has improved radically during the last few years. Lots of natural fiber use for reinforcement in rubber industries Like banana fiber, cotton fiber etc. They are cheap and give good properties. Human hair use as reinforcing agent because it is easily available, cheap, slow decomposition and give good strength. Slow decomposition of hair improves service life of composite. Human Hair is treated with Alum, Silane, and MMA. Treated human hair give better compatibility to rubber in rubber composite, it will improve physical properties of human hair rubber composite.

### II. CHEMICAL COMPOSITION OF HUMAN HAIR

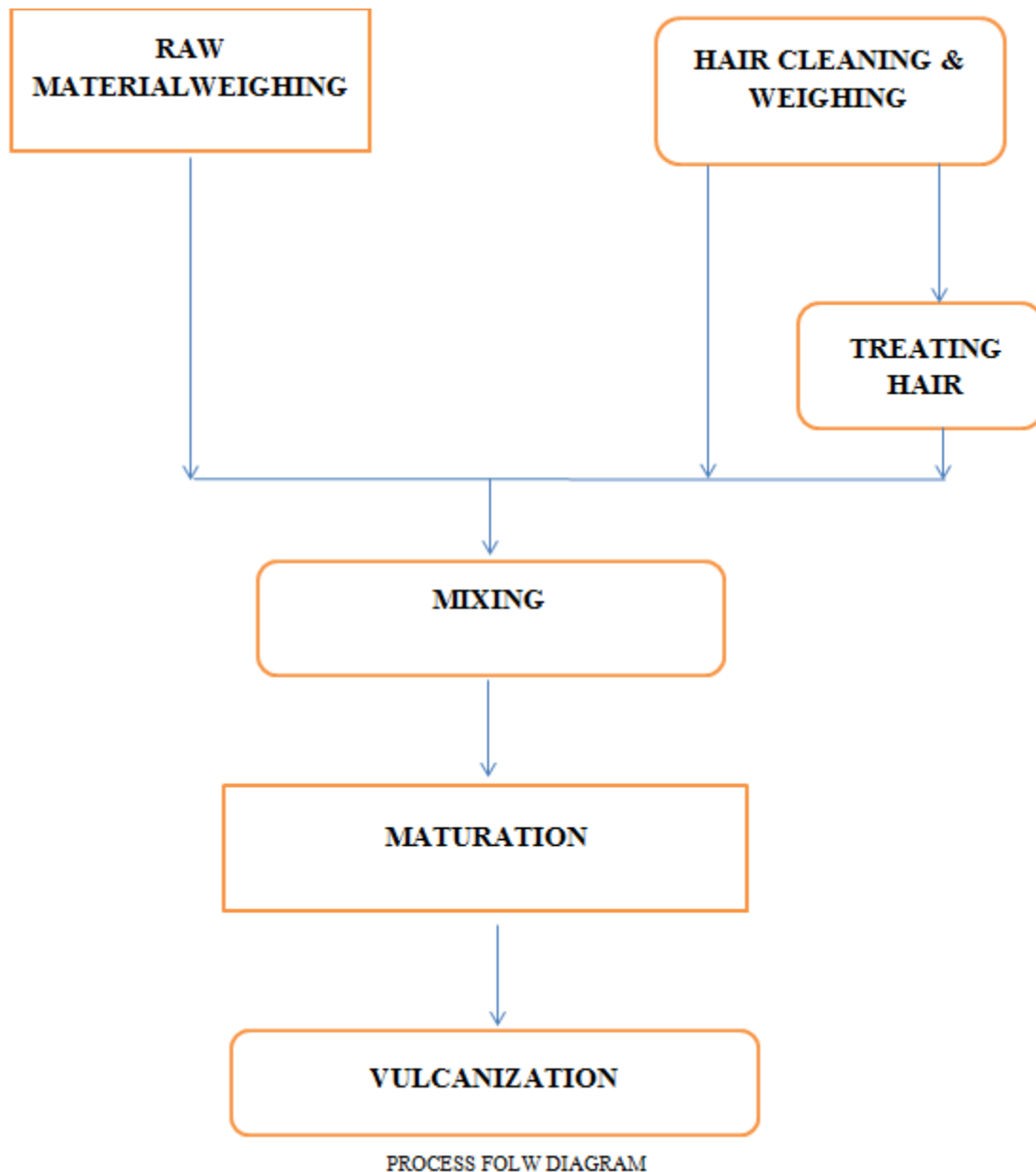
Human hair is a complex tissue consisting of several morphological components, and each component consists of several different chemical species. It is an integrated system both in terms of its structure and in terms of its chemical and physical behavior wherein its components can act separately or as a unit.

Depending on its moisture content (up to 32% by weight), human hair consists of approximately 65 to 95% proteins. Proteins are condensation polymers of amino acids, and the structures of those amino acids found in human hair. Because of the large number of chemical reactions that human hair is subjected to by chemical bleaches, alkaline straighteners, and sunlight exposure, many of these amino acids are converted to the amino acid derivatives. The remaining constituents are water, lipids (structural and free), pigment, and trace elements (generally not free, but combined chemically with side chains of protein groups or with fatty-acid groups of sorbed or bound lipid).

- General structure of amino acid human hair



### III. MANUFACTURING PROCESS:



Hair is waste material and it causes much problematic for drainage system. Normally waste human hair contains dirt, oil, and some other contamination. For using human hair as sort fiber all dirt and other contamination are must be removed. Clean hair is treated with different chemical like alum, Silane, methyl methacrylate (MMA). Alum is reacting with hair and make surface more reactive. Those activated surface are helpful for mix with rubber.

- There are following steps for treatment of hair.
1. Weighing hair as per require PHR.
  2. Take Alum as per 10 % w/w.
  3. Make 10 % w/w alum water solution.
  4. Deep the coat hair with alum solution.
  5. Take it for drying for one day.

This treated human hair and rubber additive weighing as per required PHR.

#### THE COMPOSITION OF RUBBER COMPOUNDS

COMPOUND NO	M1	M2	M3	M4	M5
INGREDIENTS					
RSS	100	100	100	100	100
ZNO	5	5	5	5	5
STEARIC acid	1	1	1	1	1
MBTS	1	1	1	1	1
SULFUR	2	2	2	2	2
HS/TDQ	0.8	0.8	0.8	0.8	0.8
HUMAN HAIR	10	10	10	10	10
RESIN	0	0	5	0	0
SILANE	0	0	0	2	0
ALUM	0	1	0	0	0
Methyl Methacrylate (MMA)	0	0	0	0	2

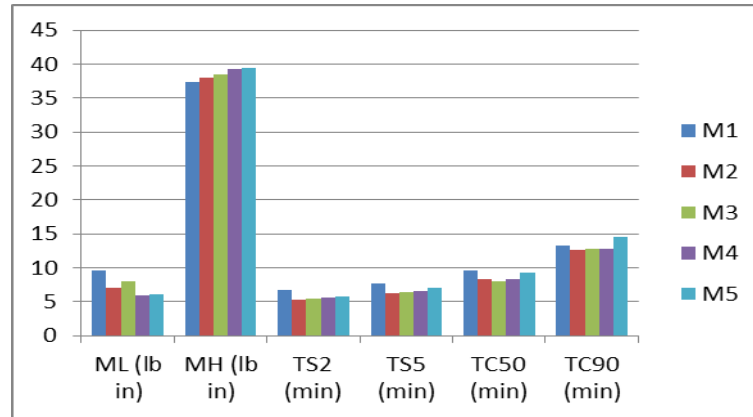
Composition of Rubber Compounds

Rubber compounds were mixed on a 2 roll mixing mill at the rolls temperature 30 °C and friction 1.15. Natural rubber sheet was successively passed through the two roll mill. Since the two rollers in a two roll mill rotates in two directions with different speeds thus producing a frictional resistance which will rise the temperature, the natural rubber is turned into a waxy state. At this state the additives are incorporated followed by the addition of human hair in sequence and mixed for roughly 3 min. Then the sulphur is incorporated. The total process took around 20 min. The vulcanization of mixed compounds was carried out in a vulcanization mold at a temperature of 140°C at time  $\tau_{90}$  determined from rheometric measurements.

#### IV. TESTING AND RESULTS

##### 4.1 Vulcanization Characteristics

Oscillating Disk rheometer used to determine the vulcanization characteristics of natural rubber and human hair compounds and also used for good quality control in rubber manufacturing processes, for research and development testing of raw-rubber compounded in an evaluation formulation, and for evaluating various raw materials used in preparing natural rubber and human hair compound.



Rheometer Data

##### 4.2 Tensile Testing:-

The natural rubber and human hair composite compound tensile testing by the ASTM 412 method. The tensile strength is measure by the universal tensile testing machine. All materials and products covered by these test methods must withstand tensile forces for adequate performance in certain applications. These test methods allow for the measurement of such tensile properties. However, tensile properties alone may not directly relate to the total end use performance of the product because of the wide range of potential performance requirements in actual use.

Calculate the tensile testing by using given formula:

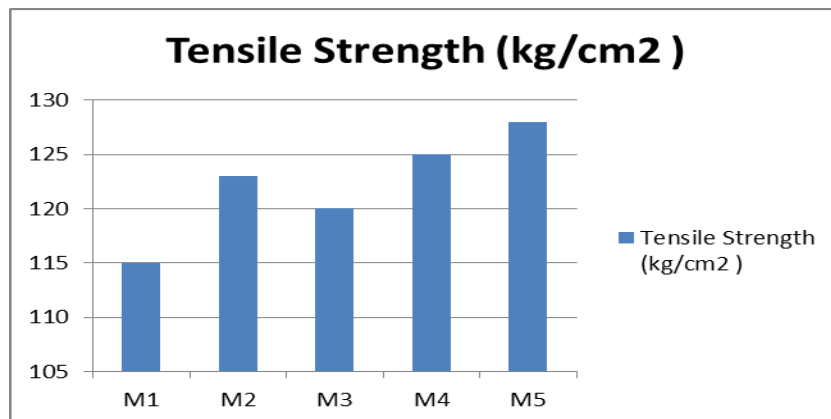
$$TS = \frac{F(BE)}{A}$$

Where:

**TS** = tensile strength, the stress at rupture, kg/cm<sup>2</sup> (lbf/in.<sup>2</sup>),

**F<sub>(BE)</sub>** = the force magnitude at rupture, kg (lbf), and

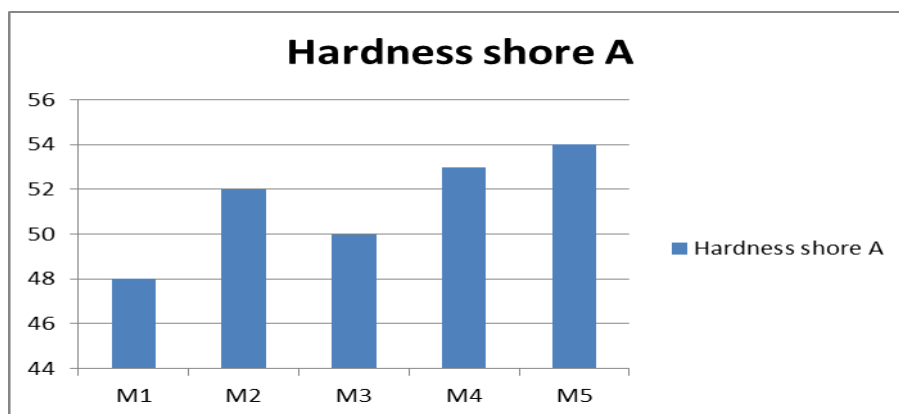
**A** = cross-sectional area of unstrained specimen, cm<sup>2</sup>(in.<sup>2</sup>).



### 4.3 Hardness testing :-

The Hardness test method is based on the penetration of a specific type of indenter when forced into the material under specified conditions. The indentation hardness is inversely related to the penetration and is dependent on the elastic modulus and viscoelastic behavior of the material.

This test method permits hardness measurements by the ASTM 2240 test method. The hardness durometer based on either initial indentation or indentation after a specified period of time, or both. Durometers with maximum reading indicators used to determine maximum hardness values of a material may yield lower hardness when the maximum indicator is used.



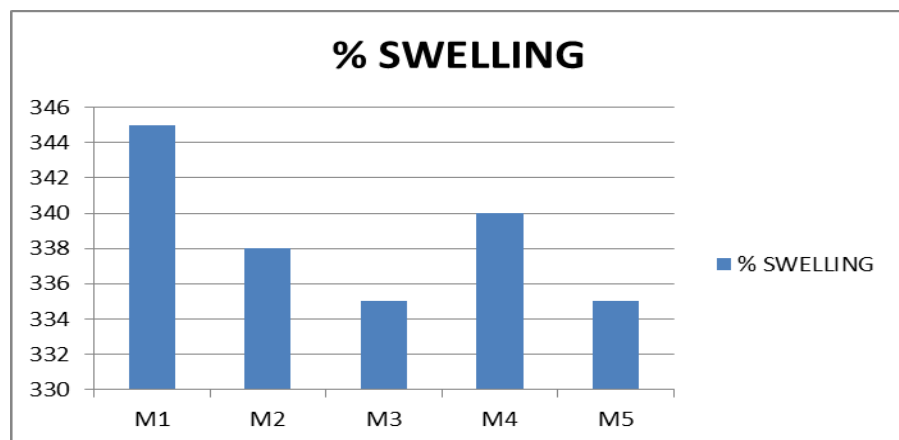
### 4.4 Swelling Parameters

The Natural rubber is swollen in a solvent with reagent grade purity, selection based on rubber type, for 24 h at room temperature. The solvent is replaced with fresh solvent three times during the swelling process. After swelling, the solvent is wiped quickly from the surface of the swollen Natural rubber using a clean paper towel. Measure the weight of the swollen sample in a preweighted and tared weighing bottle with closure. Dry it at  $70 \pm 2^\circ\text{C}$  in a forced-ventilating air oven for  $16 \pm 1$  h. Cool to room temperature in a desiccator and weigh.

The degree of swelling is determined according to ASTM D 6814-02 and calculated as

$$Q\% = \frac{m_o - m}{m_o} \times 100$$

Where,  $m_o$  and  $m$  are the weights of sample before and after the swelling test, respectively.



## **V. CONCLUSION**

Physical properties of rubber are increase with improve compatibility of human hair in composite. The tensile strength is increase with improve compatibility of human hair in composite. Methyl Methacrylate (MMA) give higher tensile strength compare to other in same composition. The swelling resistance is increase with improve compatibility of human hair in composite. Methyl Methacrylate (MMA) give higher swelling resistance compare to other in same composition. Methyl Methacrylate (MMA) give higher Hardness compare to other in same composition.

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