CHAPTER 5

SUMMARY, CONCLUSIONS AND FUTURE WORK

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CHAPTER 5

CONCLUSIONS

5.1. SUMMARY

The increased use of science and technology in developing the new materials produced high performance materials but at the same time the atmosphere is polluted a lot. The use of conventional epoxy-glass, polyester-glass etc composites increased the pollution problem. After using the engineering conventional composite components are thrown out in the atmosphere without any treatment to reduce the pollution. They are highly polluting the nature. So now focus is given to the new materials which are environmentally friendly. The natural composites are such materials have no pollution problems for the environment.

The production of natural products makes the rural economy stronger. The agricultural worker gets employment to make the natural fibers and resins. The green house gases pollute the environment. The productions of natural fibers are done through the production of plants and trees. The plant inhales the CO\textsubscript{2} gas and exhausts the O\textsubscript{2} gas. Thus the content of CO\textsubscript{2} in the environment is protected. The processing of fibers will create employment to the rural youth, they can be used as a reinforcing fibers in the composites.
1.2. **NATURAL COMPOSITES**

To use the plant fibers in the natural composites manufacturing, they should be free from fungus, bacteria etc. They should be processed carefully, and they should not have the mechanical defects like fracture. To have the best quality of the fibers, they should be studied with the high resolution camera; a study should be done with the Image analysis, so that the defects can be found easily and the fiber with defects can be rejected. The image analysis can be used to find the diameter of the fiber accurately. The SEM scanning electron microscope images can be obtained at very high magnifications. The SEM images can give an idea of the natural fiber surface.

5.3. **SPECTROSCOPY**

FTIR and Raman Spectroscopy are useful tools for studying the natural fibers. The spectroscopy is a non destruction testing. While studying the spectroscopy, the entire spectra is not needed, a part of the spectra is enough, this is called signature spectra of the natural fiber.

5.4. **DSC ANALYSIS**

All the materials are sensitive to heat and temperature. The natural fibers are more sensitive than the conventional fibers. The thermo gravimetric analysis gives the information about peak temperatures that a fiber can resist. From this work it is concluded
that lignin content influences the peak temperatures. The coir with 45% of lignin has a peak temperature of 74.6°C, jute with 9% of lignin content shows a peak temperature of 67.3°C and the hemp with 4% lignin content has a peak temperature of 54°C.

From this work it is proved that the composition of natural fiber influences the mechanical properties. The natural fiber has 5 important chemical constituents namely cellulose, hemicelluloses, lignin, pectin and waxes. There are other constituents also present in the fiber, but they are in negligible percentage. From regression analysis the influence of each constituent on a particular mechanical property is explained and an equation is also derived from the regression line.

5.5. CHEMICAL COMPOSITION OF NATURAL FIBER

If the role of individual constituents of natural fiber is to be summarized, it is as follows, the cellulose corresponds to high strength of natural plant fiber, the decreases the strength of fiber, lignin content increases the failure strain, pectin content makes natural fibers more dense the density. The content of wax in the natural fiber is small and it has the least effect to influence the properties of natural fiber.

But the chemical composition is expected to have a combined effect on the properties of natural fiber. This should be studied in detail.
5.6. TENSILE STRENGTH

The tensile strength of natural concludes that, they can be use for decorative, interior decorative parts of automotives; rail locomotives etc. Literature study shows that the chemical treatment of natural fiber, addition of fillers and binder can improve the properties of natural composites.

5.7. HYGROTHERMAL EFFECT

While the engineering products are in use, after some years of time they lose their strength. This is due to hygrothermal effect. When the composite is exposed to sunshine and humidity they lose strength considerably after a long period of exposure. The tensile test is conducted to know the hygrothermal effect on the natural composites.

5.8. BIO DEGRADATION

The natural composites made of natural fibers and starches are easily biodegradable than the other natural composites. The biodegradation takes place when the sample is exposed to atmosphere. The naturally occurring changes due to exposure to sunshine, rain, water, humidity, ultraviolet rays will disintegrate the natural composites. The composites after use can be easily buried in the ground, and then they mix up in soil. Unlike the conventional plastic composites they support the soil micro bio organisms so that the soil will be more fertile. In this the samples are buried in the soil
in a plastic mesh and the weight loss is conducted at regular intervals of time.

The hydrolysis will take place when the composite reacts with water. The water molecule penetrates into the resin and fiber. The fiber and resin de bonds easily. The fiber will be a separate entity by hydrolysis. The water penetration into the fiber hydrolyzes the hemicelluloses and disintegrates the fiber into fragments. In this way both the resin, fiber disintegrate and mix up in the soil. The exposure to sunshine makes the color change of composites that means the oxidation process is taking place. The addition of oxygen to the composite makes the composite weak and finally the composite disintegrates into pieces.

**5.9. WATER ABSORPTION**

The water absorption test shows that the starch composites absorbs more moisture than the other, this shows that the starch composites are more hydrophilic in nature.
5.10. ECO INDICATOR:

Eco indicator gives the behavior of the natural composite towards the environment. The composites with more Eco indicator number are more harmful to the nature. The natural composites are less harmful than the conventional plastic based composites. In this work first the resin and the natural fibers are assigned an Eco indicator number, then from rule of mixtures the Eco indicator number is found for the composite.

5.11. MECHANICAL PROPERTIES

The response of a composite material can be characterized from its fiber and matrix constituents.

The lower experimental values of Young’s modulus in tension are due to opening of existing voids and micro cracks. Further, the fillers that are usually added to the matrix may be one of the reasons contributing to the different response in tension and compression.

5.12. SCOPE FOR FUTURE WORK:

The main drawback of natural composites is that they are hydrophilic in nature. To have a long life for the natural composite components a mechanism should be found so that, the fiber, resin and composites are avoided the contact with water.

The literature should be made to available for industrial entrepreneurs which has data of the dimensions of the natural fibers with respect to geographical segments. So that it makes the
entrepreneurs to make a product and finds the properties of natural composites manufactured at that particular geographical location.

The natural composites are suitable for interior applications; the composites can be used for long time with a coating on the composites. The moisture and humidity resistance natural composite is to be manufactured. This can be achieved with a thin film coating of water repellant on the surface of natural composite.