BONAFIDE CERTIFICATE

Certified that this project report **"DEVELOPMENT OF SOUND PROOF BOARD USING CHICKEN FEATHER FIBER REINFORCED COMPOSITE"** is the bonafide work of

" R.DIVYALAKSHMI,J.SATHEESH KUMAR,

B.SIVAKUMAR,S.SURAJ "who carried out the project work under my supervision.

	K Saravanan
SIGNATURE	**SIGNATURE**
Dr. LOUIS D'SOUZA	Mr.K.SARAVANAN
HEAD OF THE DEPARTMENT	**SUPERVISOR**
Department of Textile Technology,	Senior Lecturer
Kumaraguru College of Technology,	Department of Textile technology
Coimbatore-641006	Kumaraguru college of Technology
	Coimbatore-641006

Viva- voce examination is conducted on 30.-4.-2009

	30/4/09
(INTERNAL EXAMINER)	(EXTERNAL EXAMINER)

ACKNOWLEDGEMENT

We the students of this project give our entire honor to '**THE ALMIGHTY**' for blessing this combined works of our hand.

We wish to thank **OUR PARENTS** for their constant encouragement,help rendered and making all the facilities to carry out this project.

We are grateful to our President **Prof.C.RAMASAMY**,Principal **Dr.JOSEPH.V.THANIKAL** and Vice Principal **Dr.M.ANNAMALAI** for providing the opportunity to carry out this project.

We take this opportunity in expressing our profound thanks to **Dr.LOUIS D'SOUZA**, Professor&Head, Department of Textile Technology, whose constant encouragement was instrumental in completing this project work.

Our sincere thanks and profound gratitude to our Project Coordinator **Prof.S.KATHIRVELU**, Professor and Project Guide **Mr.K.SARAVANAN**, Senior Lecturer for their Wonderful guidance, enthusiasm and invaluable help rendered throughout the project.

We express our sincere thanks to **Mr.DESHMUKH, ZENITH FIBRES,BARODA** for their invaluable help rendered to carry out our project

We are obliged to express our sincere thanks and gratitude to **KCT-TIFAC-CORE**, for their wonderful help for our project work.

We express our sincere thanks to **COMPOSITE TECHNOLOGY PARK,IIT,MADRAS** for their invaluable help for our project work.

Our Sincere thanks to **Dr.V.R.GIRIDEV**, Lecturer, Anna University for his invaluable help to make our project success.

We thank **Mr.J.KANAGARAJ,AUDIO PROCESSING LAB**, PSG college of technology, Coimbatore for his wonderful help for our project work.

We thank **Mr.T.GOPIKANNAN**,Lecturer, for his wonderful guidance and enthusiasm.

We thank all the **teaching and non-teaching** staff for their help during this project.

Selection of [illegible] waste

ABSTRACT

Chicken feathers are disposed into the waste stream and land filling/ animal feed without any value utilization. According to the recent survey, about 3.8 billion pounds of chicken feather are dumped as waste. This creates a major environmental pollution.

As an alternative to land filling or animal feed (which includes the cleaning of feather waste to obtain a clean source of the protein keratin), the feather keratin can be formed into value-added products finding profitable alternatives to current waste management practices. Historically, researchers have tried to use the feathers in textiles and in applications where wastes are already used, but to no avail.

In this project we have explained the new way of using the chicken feather into sound proof composites. In this regard we able to control one type of pollution (noise) using the chicken feathers which contributed another type of pollution (environmental pollution).

In this project we decided to offer the noise problems in seminar halls, TV halls and cinema theatres and produce the cost effective sound boards.

The poultry units had been identified and the feather wastes were collected. In order to remove the avian parts present along with feathers and to prevent the growth

of microorganisms, the feathers are washed with soap solution and cold water. Thus the feathers were cleaned.

Then the fibres were extracted by manual cutting with the help of scissors and the fibre properties were studied.

The extracted chicken feather fibers and polypropylene staple fibres are manually mixed in the ratio of 60:40 respectively. Then the mixed fibres are fed to the miniature carding machine and the web of 1500 GSM is produced.

The prepared webs are used to produce composites using the compression moulding machine and composite specimens are produced at different process conditions. The mechanical properties of the prepared composites are tested.

Finally, the sound proof testing is carried out for the prepared specimens and the effect of temperature, pressure and time on sound proofing are analyzed.

TABLE OF CONTENTS

NOMENCLATURE

1. S1-**170°C**,10 BAR,3 MIN
2. S2-**175** °**C**,10 BAR,3 MIN
3. S3-**180** °**C**,10 BAR, 3MIN
4. S4-175 °C**, 5 BAR**, 3 MIN
5. S5-175 °C,**10 BAR**,3 MIN
6. S6-175 °C, **15 BAR**,3 MIN
7. S7-175 °C,10 BAR,**2 MIN**
8. S8-175 °C,10 BAR,**3 MIN**
9. S9-175 °C,10 BAR,**5 MIN**
10. Sa- 100 mm * 9.9 mm * 3.6 mm(**180** °**C**,10 BAR, 3MIN)
11. Sb- 100 mm * 9.8 mm * 4 mm(**180** °**C**,10 BAR, 3MIN)
12. Sc- 100 mm * 9.8 mm * 3.8 mm(**180** °**C**,10 BAR, 3MIN)
13. Sd-65 mm * 12.8 mm * 4 mm(**180** °**C**,10 BAR, 3MIN)
14. Se-65 mm * 12.7 mm * 3.8 mm(**180** °**C**,10 BAR, 3MIN)
15. Sf-65 mm * 12.9 mm * 3.9 mm(**180** °**C**,10 BAR, 3MIN)

1. INTRODUCTION

Natural fiber reinforced polymer composites have raised great attention and interest among materials scientists and engineers in recent years due to the considerations of developing an environmental friendly material and partly replacing currently used glass or carbon fibers in fiber reinforced composites. They are high specific strength and modulus materials, low priced, recyclable and are easily available. Some experimental techniques, from micro scale to macro scale have been employed to evaluate the interfacial performances of this kind of composites. It is known that natural fibers are non-uniform with irregular cross sections which make their structures quite unique and much different with man-made fibers such as glass fibers, carbon fibers etc. Many researchers have been conducted to study the mechanical properties, especially interfacial performances of the composites based on natural fibers due to the poor interfacial bonding between the hydrophilic natural fibers such as sisal, jute and palm fibers and the hydrophobic polymer matrices. But reports on composites using bird feathers as reinforcing fibers are rare.

Materials derived from chicken feathers can be used advantageously as the reinforcing materials in polymer matrix composites. Such applications can potentially consume the huge quantity of feathers produced annually as a by-product of various poultry units worldwide. To aid the development of successful applications for chicken feather in composite making, this research work has been taken up. The objective of this investigation is to develop an eco-friendly, light weight sound proof composite from a cheap and easily available material at a lower cost.

Today much importance is given to the acoustical environment. Noise control and its principles play an important role in creating an acoustically pleasing environment. This can be achieved when the intensity of sound is brought down to a level that is not harmful to human ears. Achieving a pleasing environment can be obtained by using various techniques that employ different materials. One such technique is by absorbing the sound and converting it to thermal energy. Fibrous, porous and other kinds of materials have been widely accepted as sound absorptive materials. In this project we have attempted to produce sound proof board using chicken feather fibre reinforced composite which combines the advantages of natural fibre reinforcement and good thermal resistance of chicken feather fibre.

2. LITERATURE VIEW

This chapter deals with the structure and properties of Chicken feather fiber and Polypropylene, Composite manufacturing technique and evaluation method of fibers.

2.1 CHICKEN FEATHER FIBER

2.1.1 FEATHER STRUCTURES

Feathers' quills and fibers are both made of the protein keratin, the stuff of hair, nails, and wool. But the quill is hard and has a disorganized microscopic structure, while the fibers are soft and posses a very orderly microstructure. (Fig 2.1)

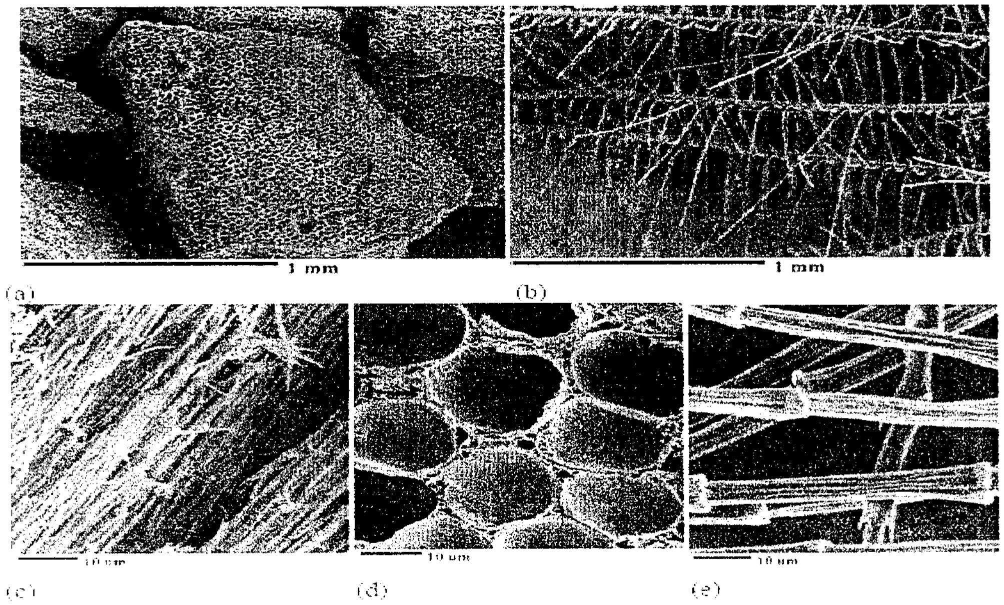


Fig 2.1 Scanning electron micrographs showing chicken feather (a) inner quill, (b) fiber, (c) outer quill, (d) inner quill, and (e) fiber.

Feathers are extremely light, and they're hollow, yet very strong. That makes them ideal." Feathers are made of the protein keratin, which in fiber form is both light and tough enough to withstand mechanical and thermal stresses. The hollow fiber is of very low density, providing strength without sacrificing weight.[2]

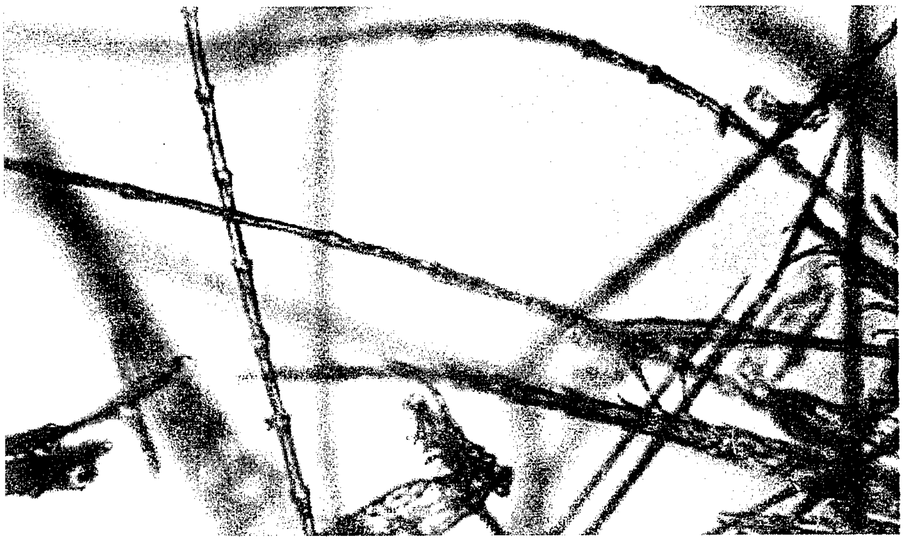


Fig 2.2 A micrograph of feathers (above) shows hollow keratin fibers, a light & tough material

2.1.2 CHICKEN FIBER FACTS

2.1.2.1 CHEMISTRY OF CHICKEN FEATHER FIBER

Chicken feather fiber primarily consists of a-helical conformations, and some ß-sheet conformations are present. Chicken feather outer quill consists almost entirely of ß-sheet conformations, and few a-helical conformations are present. Hard ß-sheet keratins have a much higher cystine content than soft a-helix keratins and thus a much greater presence of disulfide (S-S) chemical bonds which link adjacent keratin proteins (Figure

2.3). These strong covalent bonds stabilize the three-dimensional protein structure and are very difficult to break. This suggests that chicken feather outer quill would be stronger than chicken feather fiber. However, a study of the thermal properties of chicken feather fractions suggests that outer quill is weaker than fiber and inner quill.[1]

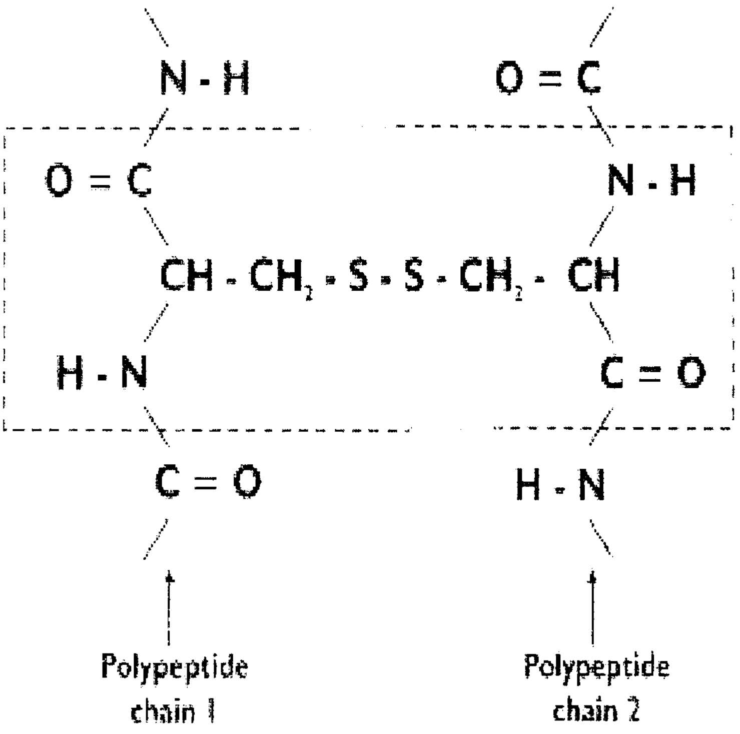


Figure 2.3 Diagrammatic representation of the diamino-acid cystine residue linking two polypeptide chains by covalent bonding

2.1.2.2 COMPOSITION OF CHICKEN FEATHER FIBER

Chicken feathers are approximately 91% protein (keratin), 1% lipids, and 8% water. The amino acid sequence of a chicken feather is very similar to that of other feathers and also has a great deal in common with reptilian keratins from claws. The sequence is largely composed of cystine, glycine, proline, and serine, and contains almost no histidine, lysine, or methionine.[2]

2.1.2.3 ELEMENTAL ANALYSIS OF CHICKEN FEATHER FIBER

Table 2.1 Elemental Analysis of chicken feather fiber

Element	**%**
Carbon	47.83
Nitrogen	13.72
Hydrogen	6.48
Sulphur	2.16
Others	29.81

2.1.3 THE PHYSICAL PROPERTIES OF CHICKEN FEATHER FIBRE

2.1.3.1 Moisture Content

Keratin can be considered to have both hydrophilic and hydrophobic properties. While 39 of the 95 amino acids in the keratin monomer are hydrophilic, serine, the most abundant amino acid, gives chicken feathers the ability to attract moisture from the air, because of the free OH^- group on the surface of each serine molecule. Thus, it may be considered to be hygroscopic.

2.1.3.2 Aspect Ratio

Fiber diameters were found to be in the range of 5-50 μm by scanning electron microscopy.

The other examination of fibers were reported to have diameters of 6-8 μm and lengths of 3-13 mm. These values correspond to aspect ratios of 400-2200. It is found that fibers had a constant diameter of approximately 5 μm and lengths between 3.2 and 13 mm. These values correspond to aspect ratios of 600-2600.[6]

2.1.3.3 Apparent Specific Gravity

The density of chicken feather fiber, obtained from Featherfiber Corporation, by displacing a known volume and weight of for the density of solid keratin. It is reported fiber lengths of 3.2-13 mm. ethanol with an equivalent amount of fiber. They reported a value of 0.89 g/cm^3 for the chicken feather fiber.[4]

The value may be higher due to the presence of shorter fibers (as short as 3.2 mm in length). The hollows, or voids, inside chicken feather fibers may become more accessible to ethanol as fiber length decreases. For a fiber of some critical length, the void inside of this fiber acts as a part of its surface, and as a result only the solid matter of this fiber will be accounted for by a measurement of apparent density. Assuming a density of 1.3 g/cm^3

for the solid matter of chicken feather fiber (keratin), apparent density results will approach 1.3 g/cm^3 as fiber length decreases.

2.1.3.4 Chemical Durability

The structure of keratin, the primary constituent of chicken feathers, affects its chemical durability. Because of extensive cross-linking and strong covalent bonding[5]
within its structure, keratin shows good durability and resistance to degradation. Efforts to extract keratin proteins from feathers illustrate this point. Extraction is a difficult task because it can only be achieved if the disulfide and hydrogen bonds are broken. Schrooyen found keratin to be insoluble in polar solvents, such as water, as well as in nonpolar solvents.[5]

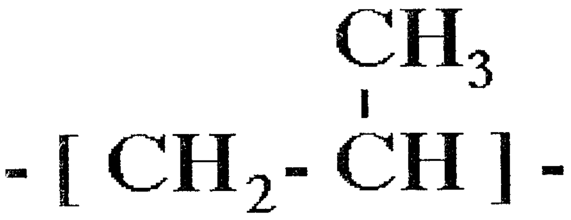
The most common method for dissolving feather keratins is solubilization with concomitant peptide bond scission via acid and alkali hydrolysis, reduction of disulfide bonds with alkaline sodium sulfide solutions, or a combination of enzymatic and chemical treatment. Although these techniques are effective for extracting keratin (75% yield), they require extremely high reagent concentrations that are much higher than keratin fibers would ever be exposed to in nature. One can deduce from this that keratin is a relatively sturdy, stable protein.

2.2 POLYPROPYLENE

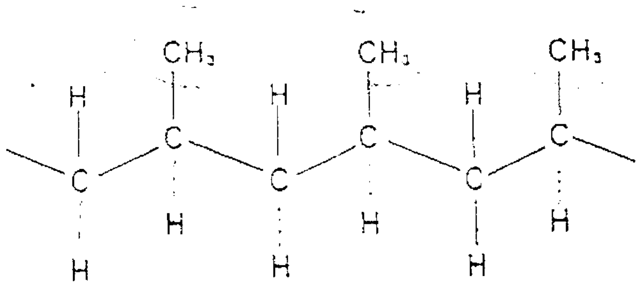
Polypropylene (PP), a polymer prepared catalytically from propylene which differs from HDPE by having an isostatic replacement of a hydrogen atom by a methyl group on alternate carbon atoms in the main chain.

Although largely unreactive chemically the presence of the methyl groups makes Polypropylene slightly more susceptible to attack by strong oxidizing agents than HDPE. A major advantage is Polypropylene's higher temperature resistance, this makes PP particularly suitable for items such as trays, funnels, pails, bottles, carboys and instrument jars that have to be sterilized frequently for use in a clinical environment. Polypropylene is a translucent material with excellent mechanical properties and it has gradually replaced the polyethylenes for many purposes[3]

2.2.1 STRUCTURE



$$-[\,CH_2-\overset{\overset{CH_3}{|}}{CH}\,]-$$



POLYPROPYLENE-REPEATING UNIT

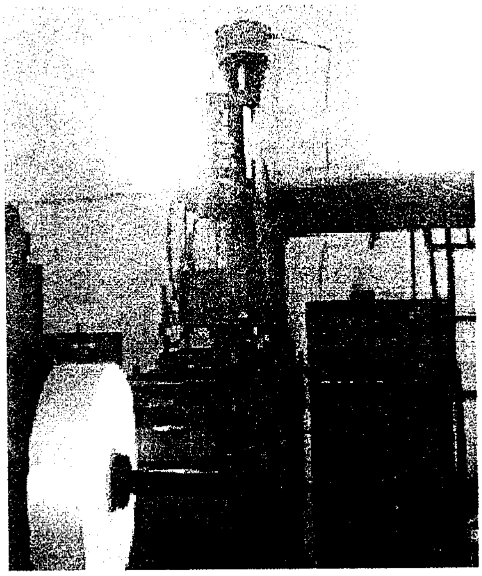


Fig 2.4 Polypropylene manufacturing machine

2.2.2 PROPERTIES

Homopolymer polypropylene is translucent, Colorless transparent, smooth and glossy with hard surface, strong, highly resistant to temperature changes and with electrical insulation properties. Water-resistant, water repellant and physiologically harmless.

Glass transition temperature: 10°C.
Melting temperature: 173°C.
Amorphous density at 25°C: 0.85 g/cm^3.
Crystalline density at 25°C: 0.95 g/cm^3.
Molecular weight of repeat unit: 42.08 g/mol.

Table 2.2 Properties of Polypropylene

Physical properties

Density (g cm^{-3})	0.9
Flammability	HB
Limiting oxygen index (%)	18
Radiation resistance	Fair
Refractive index	1.49
Resistance to Ultra-violet	Poor

Mechanical Properties

Abrasive resistance - ASTM D1044	13-16 mg/1000 cycles
Coefficient of friction	0.1-0.3
Elongation at break (%)	150-300, for biax film >50
Hardness – Rockwell	R80-100
Izod impact strength (J m^{-1})	20-100
Tensile modulus (GPa)	0.9-1.5, for biax film 2.2-4.2,
Tensile strength (MPa)	25-40, for biax film 130-300,

Thermal Properties

Coefficient of thermal expansion	100-180 ($x10^{-6}\ K^{-1}$)
Heat-deflection Temperature	100-1050.45MPa (C)
Heat-deflection temperature	60-651.8MPa (C)
Lower working temperature	10 to -60(C)
Specific heat	1700 - 1900($J\ K^{-1}\ kg^{-1}$),
Thermal conductivity @23C	0.1-0.22($W\ m^{-1}\ K^{-1}$)
Upper working temperature	90-120(C)

Chemical Resistance

Acids – concentrated	Good-Fair
Acids – dilute	Good-Fair
Alcohols	Good
Alkalis	Good
Aromatic hydrocarbons	Fair
Greases and Oils	Good-Fair
Halogenated Hydrocarbons	Good-Poor
Halogens	Poor
Ketones	Good

Electrical properties

Dielectric constant @1MHz	2.2-2.6
Dielectric strength (kV mm^{-1})	30-40
Dissipation factor @ 1MHz	0.0003 - 0.0005
Surface resistivity (Ohm/sq)	10^{13}
Volume resistivity (Ohmcm)	10^{16}-10^{18}

2.3 THERMO GRAVIMETRIC ANALYSIS

Thermo gravimetric Analysis or TGA is a type of testing that is performed on samples to determine changes in weight in relation to change in temperature. Such analysis relies on a high degree of precision in three measurements: weight, temperature, and temperature change. As many weight loss curves look similar, the weight loss curve may require transformation before results may be interpreted. A derivative weight loss curve can be used to tell the point at which weight loss is most apparent. Again, interpretation is limited without further modifications and deconvolution of the overlapping peaks may be required.

TGA is commonly employed in research and testing to determine characteristics of materials such as polymers, to determine degradation temperatures, absorbed moisture content of materials, the level of inorganic and organic components in materials, decomposition points of explosives, and solvent residues. It is also often used to estimate the corrosion kinetics in high temperature oxidation.

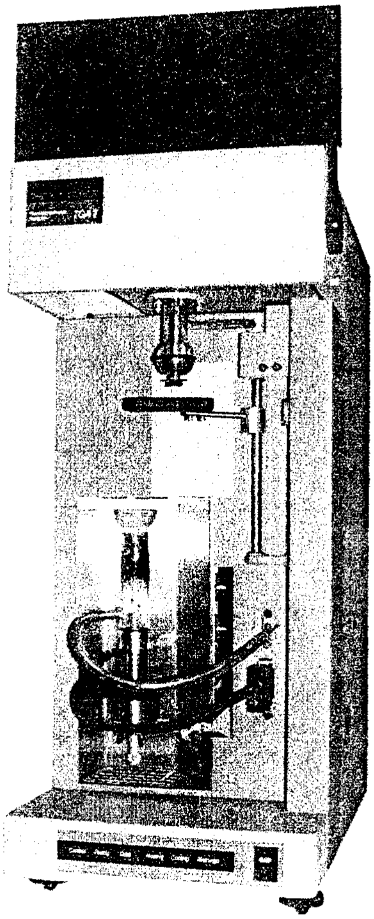


Fig.2.5 Thermogravimetric Analyser

The analyzer usually consists of a high-precision balance with a pan loaded with the sample. The sample is placed in a small electrically heated oven with a thermocouple to accurately measure the temperature. The atmosphere may be purged with an inert gas to prevent oxidation or other undesired reactions. A computer is used to control the instrument.

Analysis is carried out by raising the temperature gradually and plotting weight against temperature. After the data is obtained, curve smoothing and other operations may be done such as to find the exact points of inflection. Background Thermogravimetric analysis involves heating a sample in an inert or oxidising atmosphere and measuring the weight. The weight change over specific temperature ranges provides indications of the composition of the sample and thermal stability. Applications include: Asesssment of moisture and volatiles Asesssment of composition Thermal stability Oxidative stability Decomposition kinetics

A simplified explanation of a TGA sample evaluation may be described as follows.

- A sample is placed into a tared TGA sample pan which is attached to a sensitive microbalance assembly.
- The sample holder portion of the TGA balance assembly is subsequently placed into a high temperature furnace.
- The balance assembly measures the initial sample weight at room temperature and then continuously monitors changes in sample weight (losses or gains) as heat is applied to the sample.
- TGA tests may be run in a heating mode at some controlled heating rate, or isothermally.
- Typical weight loss profiles are analyzed for the amount or percent of weight loss at any given temperature, the amount or percent of noncombusted residue at some final temperature, and the temperatures of various sample degradation processes.

2.4 Fourier Transform Infrared Spectroscopy (FTIR)

2.4.1 FTIR - Introduction

FTIR is most useful for identifying chemicals that are either organic or inorganic. It can be utilized to quantitate some components of an unknown mixture. It can be applied to the analysis of solids, liquids, and gasses. The term Fourier Transform Infrared Spectroscopy (FTIR) refers to a fairly recent development in the manner in which the data is collected and converted from an interference pattern to a spectrum. Today's FTIR instruments are computerized which makes them faster and more sensitive than the older dispersive instruments.

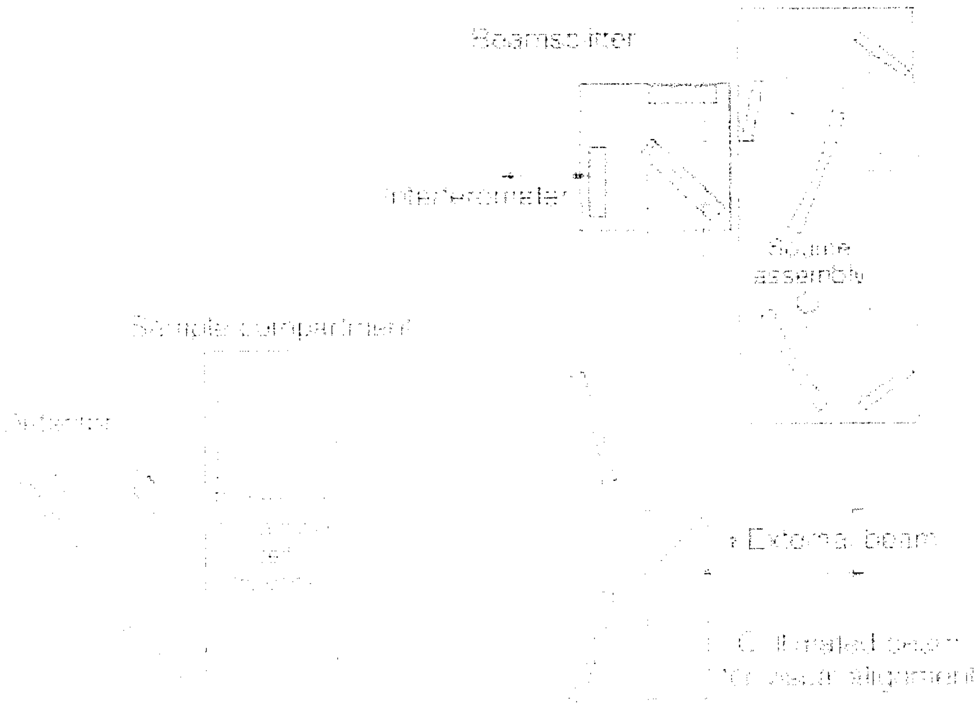


Fig 2.6 Optical Diagram of FTIR spectroscopy

2.4.1.1 Qualitative Analysis

FTIR can be used to identify chemicals from spills, paints, polymers, coatings, drugs, and contaminants. FTIR is perhaps the most powerful tool for identifying types of chemical bonds (functional groups). The wavelength of light absorbed is characteristic of the chemical bond as can be seen in this annotated spectrum.

By interpreting the infrared absorption spectrum, the chemical bonds in a molecule can be determined. FTIR spectra of pure compounds are generally so unique that they are like a molecular "fingerprint". While organic compounds have very rich, detailed spectra, inorganic compounds are usually much simpler. For most common materials, the spectrum of an unknown can be identified by comparison to a library of known compounds. WCAS has several infrared spectral libraries including on-line computer libraries. To identify less common materials, IR will need to be combined with nuclear magnetic resonance, mass spectrometry, emission spectroscopy, X-ray diffraction, and/or other techniques.

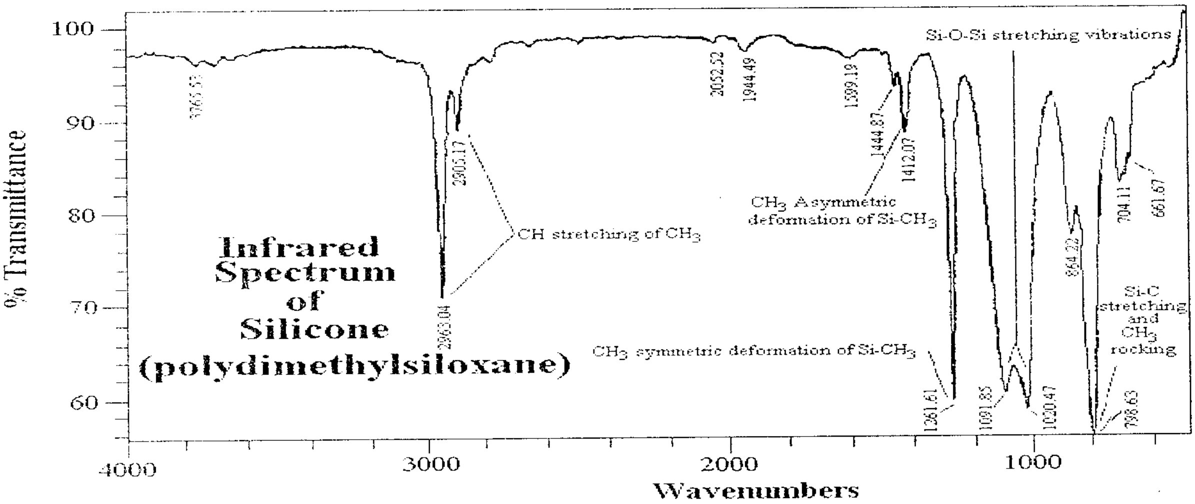


Fig 2.7 INFRARED SPECTRUM OF SILICONE

2.4.1.2 Quantitative Analysis

Because the strength of the absorption is proportional to the concentration, FTIR can be used for some quantitative analyses. Usually these are rather simple types of tests in the concentration range of a few ppm up to the percent level. For example, EPA test methods 418.1 and 413.2 measure the C-H absorption for either petroleum or total hydrocarbons. The amount of silica trapped on an industrial hygiene filter is determined by FTIR using NIOSH method 7602.

2.4.1.3 Physical Principles

Molecular bonds vibrate at various frequencies depending on the elements and the type of bonds. For any given bond, there are several specific frequencies at which it can vibrate. According to quantum mechanics, these frequencies correspond to the ground state (lowest frequency) and several excited states (higher frequencies). One way to cause the frequency of a molecular vibration to increase is to excite the bond by having it absorb light energy. For any given transition between two states the light energy (determined by the wavelength) must exactly equal the difference in the energy between the two states [usually ground state (E_0) and the first excited state (E_1)].

Difference in Energy States = Energy of Light Absorbed

$E1 - E0 = h\ c\ /\ l$

Where

h = Planks constant

c = speed of light, and

l = the wavelength of light.

The energy corresponding to these transitions between molecular vibrational states is generally 1-10 kilocalories/mole which corresponds to the infrared portion of the electromagnetic spectrum.

2.4.1.4 Sample Preparation

Samples for FTIR can be prepared in a number of ways. For liquid samples, the easiest is to place one drop of sample between two plates of sodium chloride (salt). Salt is transparent to infrared light. The drop forms a thin film between the plates. Solid samples can be milled with potassium bromide (KBr) to form a very fine powder. This powder is then compressed into a thin pellet which can be analyzed. KBr is also transparent in the IR. Alternatively, solid samples can be dissolved in a solvent such as methylene chloride, and the solution placed onto a single salt plate. The solvent is then evaporated off, leaving a thin film of the original material on the plate. This is called a cast film, and is frequently used for polymer identification. Solutions can also be analyzed in a liquid cell. This is a small container made from NaCl (or other IR-transparent material) which can be filled with liquid, such as the extract for EPA 418.1 analysis. This creates a longer path length for the sample, which leads to increased sensitivity. Sampling methods include making a mull of a powder with a hydrocarbon oil (Nujol) or pyrolyzing insoluble polymers and using the distilled pyrolyzate to cast a film. Films can be placed in an Attenuated Total Reflectance cell and gases in gas cells.

2.5 Introduction to Thermoplastic Composite Materials

Throughout the prior two decades, fiber reinforced composite materials were principally fabricated using thermosetting matrices. Disadvantages stemming from the use of thermosets include brittleness, lengthy cure cycles and inability to repair and/or recycle damaged or scrapped parts. These disadvantages led to the development of the thermoplastic matrix composite system. Compared with thermosets, composites fabricated from thermoplastic materials typically have a longer shelf life, higher strain to failure, are faster to consolidate and retain the ability to be repaired, reshaped and reused as need arises. However, as in many polymer composite systems, these materials frequently suffer from a lack of adequate fiber-matrix adhesion. In addition, the use of thermoplastics introduces the problem of adequate fiber tow penetration. Thermoplastic melts, as opposed to thermosetting resins, have a substantially higher viscosity. Thermoplastic matrices must be able to withstand high temperatures in order to effect a sufficient reduction in viscosity. Additional problems caused by high matrix viscosity during consolidation include de-alignment of reinforcing fibers during consolidation as well as the introduction of voids within the final composite product. All of these problems can be addressed by appropriate design regarding the fiber-matrix interface as well as optimization of composite fabrication procedures. Composites prepared with satisfactory matrix dispersion within the fiber tows as well as reasonable fiber-matrix adhesive interaction typically results in composites with good mechanical properties.[16]

2.6 FABRICATION TECHNIQUES FOR THERMOPLASTIC COMPOSITES

The first step in the design of a thermoplastic composite material is an appropriate choice of a fabrication method. There are several widely used methods to prepare thermoplastic composite materials, several of which are outlined below.

2.6.1 SOLUTION IMPREGNATION

The solubility of thermoplastics as opposed to thermosetting materials has led to the use of solution deposition and impregnation of matrix material onto fiber tows. 'Solution Prepregging' is a common technique used to fabricate thermoplastic composite materials. This process entails solubilizing the matrix polymer at a suitable concentration and then immersing the fiber tow within the solution. In the ideal case, the polymer solution will individually wet each filament within the fiber tow. Once the fiber has been coated with solution, the fiber article is then removed from solution and the solvent must be evaporated before further fabrication steps are taken. Prepreg tows are then conventionally arranged in sheet form after which they are consolidated in a hot press to produce a composite article.

2.6.2 POWDER IMPREGNATION/PULTRUSION

Another method of preparing composite performs is powder impregnation. In this case, the fabric or sheet reinforcement is impregnated with a suspension of fine (<5 micrometers) polymer particles. The method is restricted to polymer matrices or precipitated from solution. Pultrusion operates in a similar manner. Fiber tow is pulled through powdered resin (30-250 micrometers) in a coating unit and then shaped and heated within a die. Pultruded tow is then arranged in sheet form and consolidated within a hot press.[20]

2.6.3 FILM STACKING

Film stacking is a third technique with which to prepare thermoplastic composites. In this case, fiber tows arranged in sheet form are sandwhiched between matrix polymer films. This assembly is then placed within a press where temperature transforms the film into a polymer melt. Pressure is then applied and forces the melt to impregnate the fiber tow. Appropriate process conditions must be used in order to sufficiently reduce the matrix viscosity without thermally degrading the actual composite or de-align the fibrous reinforcement. Insufficient heat input and/or pressure will typically result in unwetted fiber and a high void content within the final material.[20]

2.6.4 CONSOLIDATION OF THERMOPLASTIC PREFORMS

After preparation, thermoplastic prepregs are then arranged in sheet form and stacked in either a unidirectional or cross-ply manner. This stack is then pressed within a mould under pressure and temperature. During pressing, a vacuum is frequently used in order to remove any air or solvents used to process the prepregs. The use of vacuum during the final consolidation step can aid in the reduction of voids within the final composite article. Optimal process parameters, such as residence time, temperature and pressure must all be determined for the particular composite system and perform fabrication method.

2.6.5 HAND AND MACHINE LAY-UP

This is the simplest way of manufacturing composites fiber. In this method the fabric layers are placed on a mould with resin applied to a successive layers until the desired thickness is reached. A gel coat is applied on the mould for better quality surface. Prepegs are very suitable for hand lay-up techniques to avoid any wetting process. Prepegs are yarns or fabrics that are already impregnated or melted with resin. A roller is used to remove the entrapped air, control the thickness and guarantee good wet out and smooth surface. The curing usually takes place at room temperature or under heat to speed up the process. Usually Polyester and Epoxy resin is used for hand lay-up.

Machine lay-up is automated from the hand lay-up. Computer controlled automatic tape lying machines are used to lay down fiber to fabric. This process provides consistency and increased speed.[20]

2.7 VARIOUS MOULDING TECHNIQUES

Some of the most common industrial manufacturing processes for polymers include:

Spray-up moulding
Compression moulding
Transfer moulding
Rotational moulding

Injection moulding

Blow moulding

Vaccum forming

Extrusion

Pultrusion

2.7.1 Spray-up moulding

Chopped fibers and resins are simultaneously deposited on a mould using spraying equipment. Gel coat is applied by spray gun. Curing takes place at room or elevated temperatures. Polyester and epoxy resins are used.

2.7.2 Compression moulding

Compression moulding is the process by which thermosetting polymers are usually formed (Figure 2.8).

The compression moulding process involves placing the polymer 'dough' into the die cavity. This 'dough' is carefully measured to avoid waste and minimise the amount of 'flashing' (fine, thin webs attached to the moulding) around the finished article.

Figure 3a. With the dies apart, the prepared polymer 'dough' is placed into the cavity.

Figure 3b. With the die closed, the article is formed and the small amount of flashing on each side will be removed later.

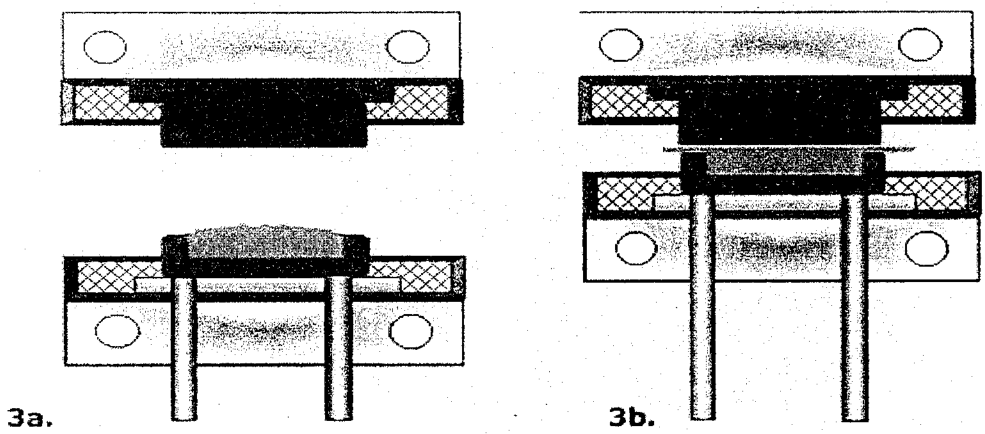


Fig 2.8COMPRESSION MOULDING

When the die is closed, heat and pressure is maintained until the condensation polymerisation process is completed.

The hot compression moulding process is used to form components from phenolic, urea and melamine thermosetting polymers, as well as alkyd resins.

2.7.3 Transfer moulding

Transfer moulding is different to compression moulding because the plastic is not fed directly into the die cavity. Instead it is fed into a chamber outside the die. Here it is preheated before a piston forces it through a system of runners and gates that allow it into the die cavity. When the polymer is cured through heat and pressure it is ejected from the mould. The advantage of this process is that the runner system allows the simultaneous production of many small, intricate parts and there is no 'flashing' around the finished article.[20]

2.7.4 Rotational moulding

Rotational moulding is a unique process for manufacturing thermosoftening polymers as it produces hollow items eg. Lawnmower grass-catchers, balls and some types of children's toys. A split mould is filled with exactly the right quantity of polymer which is then tumbled in the mould once it is bolted together. The die is rotated in a heated chamber until the polymer is completely melted. The die is removed from the chamber and continues to rotate until the polymer is set. The die halves are separated and the article removed.[20]

2.7.5 Injection moulding

In this process thermosoftening polymer powder, or granules, are placed into a feed hopper connected to a heating chamber. When the fluid state is attained, due to the heat, a piston or 'screw type' mechanism forces the plastic through a nozzle and into the die. These are often water-cooled to hasten setting such that when the plastic becomes solid again the die is opened and the component is ejected. Any flashing is then removed.

Modern technology and sophisticated metal machining and finishing techniques means that large objects with fine tolerances are easily produced.

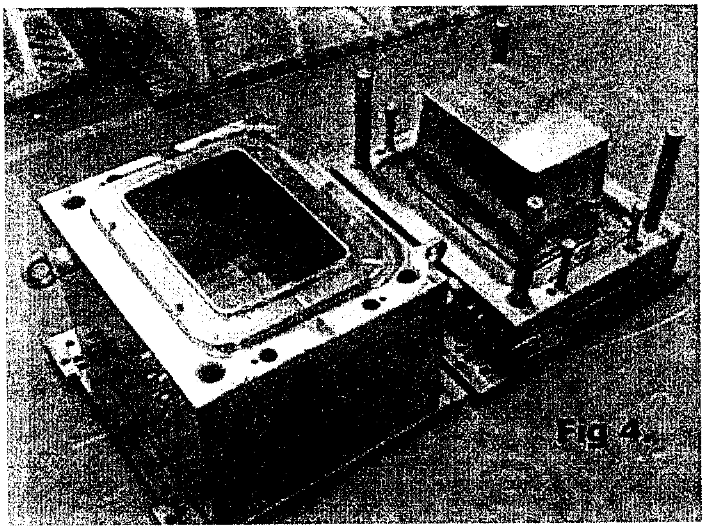
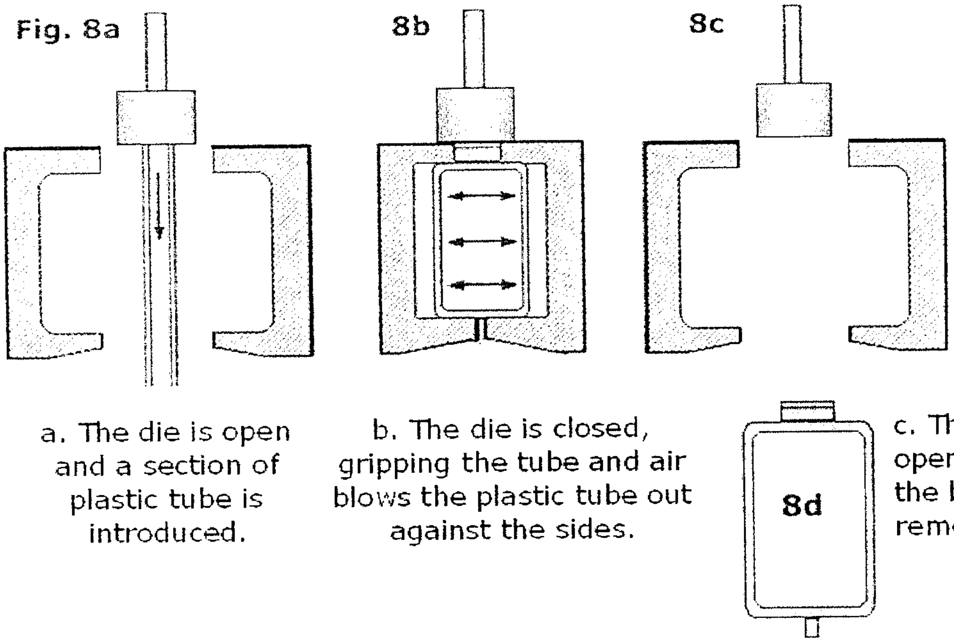


Fig 2.9 This complete die weighs in excess of 1.5 tonnes. Note the 4 alignment pins and the ejector pins.

2.7.6 Blow moulding

Thermoplastic polymer articles, such a soft drink bottles made from PET (polyethyleneteraphthalate), are formed by blow moulding. A hot, thin extruded tube (Figure 8a) of the polymer is gripped in a die as an internal blast of air forces it out against the sides of the mould (Figure 8b). It is held in the die until it cools and is then released (Figure 8c). The polymer assumes the shape of the die (Figure 8d).



a. The die is open and a section of plastic tube is introduced.

b. The die is closed, gripping the tube and air blows the plastic tube out against the sides.

c. The die is opened and the bottle is removed

Fig 2.10 BLOW MOULDING

With the die closed and the tube pinched, the air pressure, which has blown the bottle to shape, is maintained until the plastic is cooled to room temperature.

2.7.7 Vacuum forming

Vacuum forming relies upon air pressure to form a shape. A heated sheet of polymer is clamped above a mould and the air in the mould is evacuated leaving a partial vacuum. The air pressure above the mould forces the plastic sheet down into the mould to form the shape which is removed when cooled. This process is often used for transparent canopies and covers over lit signs such as those seen in service stations or fast food outlets.[20]

2.7.8 Extrusion

Extrusion (Figure 2.11) involves the use of powder or granules, mixed with dyes as required, which are placed into a feed hopper connected to a heating chamber.When the fluid state is attained due to the heat, a piston or 'screw type' mechanism forces the plastic through a nozzle and into the mould or die. The dies are often water-cooled to hasten setting such that when the plastic becomes solid again the die is opened and the component is ejected. Any flashing is then removed. [20]

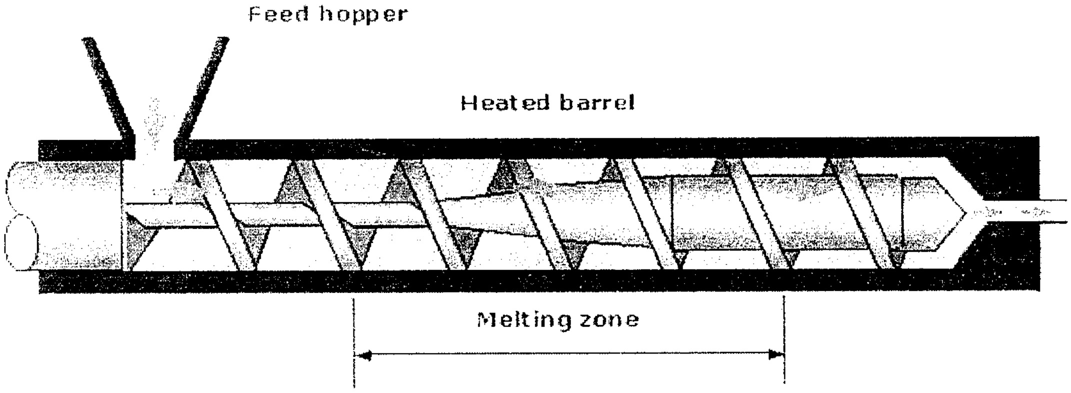


Fig 2.11 EXTRUSION

2.7.9 Pultrusion

Pultrusion is similar to extrusion except that thermosetting polymers are used and the composition of the composite polymer requires a greater force to move it through the die. For this reason, a pulling force is incorporated into the forming process to overcome resistance during manufacture of the article.[20]

2.8 COMPRESSION MOULDING MACHINE

The compression-moulding machine which was used has the following features:

1. Insulated from all four sides for effective heat insulation.
2. Six heating coils at uniform distance to have a uniform heat distribution on both platens.
3 .Sensitive PID controllers with K type sensors at different places averaging out the temperatures on the platens.
4. A timer to accurately control the timings.
5. Three sets of brass heaters on the upper and lower platens at a uniform distance, ensures that the distribution of heat on the platens is proper and uniform.

2.8.1 WORKING OF COMPRESSION MOULDING MACHINE

The compression-moulding machine (Fig 2.12) with hydraulic system of loading was employed in this work, which comprises of six heating coils, three on top plate and three on the bottom plate. The moulding process is explained with help of a flow chart.

The cool mould is taken

↓

Web is placed on the mould

↓

Set the temperature in the compression moulding machine

↓

Keep the two heating tables in contact in the machine by lifting the lever

↓

After the set temperature is reached , the lever is pulled up

↓

Now the mould is placed on the heating table and the heating tables are again closed

↓

Set the require pressure and allow the mould inside for test time

↓

Extraction of Composite sample from the mould

Fig.2.12 Compression Moulding Machine

2.8.2 TECHNICAL SPECIFICATIONS OF COMPRESSION MOULDING MACHINE

Maximum capacity	-	20 Tons
Type	-	4 Pillars and Plates
Acting	-	Single acting
Movement	-	Upward stroke
Platen size	-	300*300 mm
No of day light	-	Single
Day light gap	-	150 mm

Stroke length - 150 mm

Piston diameter - 120 mm

No of heaters - 3 nos, 500 watts in each plate

Maximum temperature - 300°

Temperature accuracy - +/- 5°

Heaters - Cartridge type Electrical Heater dia 25 mm

Heater Controls - Digital temperature Controllers "J" type

Timer - Digital type

Oil tank capacity - 15 liters

Maximum Operating Pressure - 500 bar

3. SOUND PROOFING MARERIALS

3.1 SOUND WAVE:

A sound wave is a longitudinal wave where particles of the medium are temporarily displaced in a direction parallel to energy transport and then return to their original position . The vibration in a medium produces alternating waves of relatively dense and sparse particles – compression and rarefaction respectively (shown in Figure 1.1).

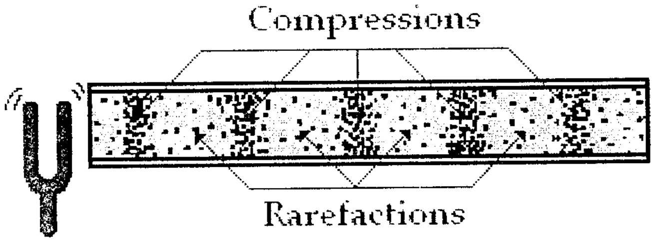


Figure 3.1.a . Alternative patterns of dense and sparse particles

The resultant variation to normal ambient pressure is translated by the ear and perceived as sound. A simple sound wave is illustrated in Figure 1.2 and may be described in terms of variables like: Amplitude, Frequency, Wavelength, Period and Intensity.

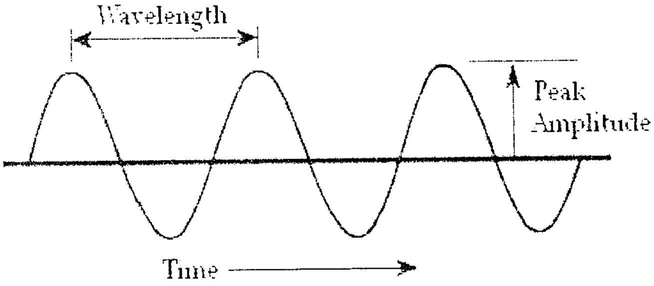


Figure 3.1.b Illustration of simple sound wave

Amplitude refers to the difference between maxima and minima pressure . **Frequency** of a wave is measured as the number of complete back-and-forth vibrations of a particle of the medium per unit of time. A commonly used unit for frequency (f) is the Hertz (abbreviated Hz). The **wavelength** (?) of a wave is the distance which a disturbance travels along the medium in one complete wave cycle .since a wave repeats its pattern once every wave cycle, the wavelength is sometimes referred to as the length of the repeating patterns.

The term '**period**' can be defined as the time required for the completion of one cycle of wave motion . The **intensity** of a sound wave is defined as the average rate at which sound energy is transmitted through a unit area.

Frequency and wavelength are related as follows :

Wavelength [ft] = Speed of sound [ft/sec]/ Frequency [Hz]

Like any wave, the speed of sound (v) refers to how fast the disturbance is passed from particle to particle. Under normal condition of pressure and humidity at sea level, sound waves travel at approximately 344 m/s through air . As explained earlier frequency refers to the number of vibrations, which an individual particle makes per unit of time, while speed refers to the distance, which the disturbance travels per unit of time .[17]

3.2. NOISE CONTROL

"Noise is an unwanted sound and unfortunately most of the machines that have been developed for industrial purposes, for high speed transportation, or to make life more enjoyable are accompanied by noise" . A noise system can be broken down into three elements :

- Noise Source – The element which disturbs the air
- Noise Path – The medium through which the acoustical energy propagates from one point to another
- Noise Receiver – The person who could potentially complain about the quantity or level of noise as perceived at same point

It is necessary to treat at least one element in the noise system if the perceived level of the noise is to be reduced. By reducing the noise level at the source or along the path, the noise level at the receiver is accordingly reduced. Treating the receiver individually in such a way to minimize the sensitivity to high noise levels is another option. But this method is not often followed because of cost of redesign, develop and retool. Treatment of noise receiver is the least desirable approach since each receiver must be treated individually. Treatment of the noise path is conceptually the simplest and therefore the most common approach to a localized noise problem. The approach is to place the material in the path of the noise (generally between the noise source and the noise receiver) so that the level of noise at the receiver is reduced . In general four basic principles are employed to reduce noise : isolation, absorption, vibration isolation and vibration damping. The study here is focused only on the absorption phenomenon of sound, where sound energy is converted into thermal energy.[17]

3.3 PRINCIPLES OF SOUND ISOLATION

3.3.1. Mass

Firstly there's mass. Mass impedes the transmission of sound in a simple way - its harder for sound to shake a very heavy thing. If your were to rely solely upon mass for sound reduction then you would need to make very large changes in mass to make large changes in performance. Typically doubling the mass of a panel without an air cavity will improve the sound isolation by 6dB.

The most common mistake made by many is to add an extra layer of plasterboard to a wall. Although this shows an improvement without looking and addressing the other principles here there will not be a great deal of improvement. In fact on a common single stud timber wall, doubling the number of plasterboard layers will yield an improvement of 3-4dB.[19]

3.3.2. Mechanical Isolation or De-coupling

Mechanical Isolation is probably the most used method of improving sound isolation but probably one of the least understood. The most common was to achieve this is using Sound Breaker Bars, staggered studs, double studs, etc. These are all doing the same thing which is to inhibit the movement of sound from one side of the construction to the other through mechanical paths such as studs or joists. Creating an air cavity in the wall will ensure the vibration has to pass through it where some of it will be lost.

This method of isolation is frequency dependant. When you decouple you create a resonance, and only above that resonance does it help you.[19]

3.3.3. Absorption

Typically sound insulation material in a wall or ceiling cavity will increase the sound isolation by eliminating/removing/destroying some of the sound. In this situation it can also benefit by lowering the resonant frequency of decoupled walls, less so at very low frequencies.

Absorption won't be much use if you don't have a decoupled construction however. In a stud wall for example sound can easily pass through the timber without the need to go through the sound insulation if not decoupling is present.[19]

3.3.4. Resonance

Resonance makes it easy for sound to vibrate a construction such as a wall. Even if you took a good, decoupled, insulated wall at a resonant frequency it will still vibrate very easily. A vibrating wall will vibrate the air on the other side, thus resonance will increase the ease for the sound to be transmitted.

Mechanical Damping can help reduce the magnitude of the resonance and therefore reducing the sound exiting the wall on the other side. The best method for dealing with this is to apply an visco-elastic layer within the construction to create the damping effect.[19]

3.3.5. Conduction

Conduction will stop a non de-coupled construction from attaining a high level of performance. Conduction plays a big role in Flanking Noise by allowing the solid materials to allow vibrations to transmit directly through unopposed.

To reduce conduction you need to mechanically isolate to separate out the solid masses and/or dampen the structure which will dissipate the energy as it travels through, both ultimately lowering the conduction significantly to a point where its not an important factor.[19]

3.4 SOUND ABSORPTIVE MATERIALS

Materials that reduce the acoustic energy of a sound wave as the wave passes through it by the phenomenon of absorption are called sound absorptive materials . They are commonly used to soften the acoustic environment of a closed volume by reducing the amplitude of the reflected waves. Absorptive materials are generally resistive in nature, either fibrous, porous or in rather special cases reactive resonators . Classic examples of resistive material are nonwovens, fibrous glass, mineral wools, felt and foams. Resonators include hollow core masonry blocks, sintered metal and so on. Most of these products provide some degree of absorption at nearly all frequencies and performance at low frequencies typically increases with increasing material thickness . Porous materials used for noise control are generally categorized as fibrous medium or porous foam. A particular interest of this research is to conduct a systematic study on fibrous sound absorbing materials. Fibrous media usually consists of glass, rock wool or polyester fibers and have high acoustic absorption. Sometimes fire resistant fibers are also used in making acoustical products . Often sound barriers are confused with sound absorbing materials. Generally materials that provide good absorption are poor barriers. Unlike, barriers and damping materials, the mass of the material has no direct effect on the performance of the absorptive materials [17]. The performance of absorptive materials depends on many parameters, which are explained in the latter part of this chapter. Absorptive materials are almost always used in conjunction with barriers of some type since their porous construction permits some noise to pass through relatively unaffected . An absorber, when backed by a barrier, reduces the energy in a sound wave by converting the mechanical motion of the air particles into low-grade heat. This action prevents a buildup of sound in enclosed spaces and reduces the strength of reflected noise [17]. The porous nature of absorptive materials renders them susceptible to contamination, moisture retention and deterioration due to physical abuse. To avoid these problems, facings may be attached to at least one side of the absorber. The addition of a facing to acoustical foam has the effect of increasing the lower frequency absorption at the expense of the higher frequencies [17].

3.5 MECHANISM OF SOUND ABSORPTION IN FIBROUS MATERIALS

The absorption of sound results from the dissipation of acoustic energy to heat. Many authors have explained this dissipation mechanism in the past Fridolin et al. [40] describe the mechanism of sound dissipation as: when sound enters porous materials, owing to sound pressure, air molecules oscillate in the interstices of the porous material with the frequency of the exciting sound wave. This oscillation results in frictional losses. A change in the flow direction of sound waves, together with expansion and contraction phenomenon of flow through irregular pores, results in a loss of momentum. Owing to exciting of sound, air molecules in the pores undergo periodic compression and relaxation. This results in change of temperature. Because of long time, large surface to volume ratios and high heat conductivity of fibers, heat exchange takes place isothermally at low frequencies. At the same time in the high frequency region compression takes place adiabatically. In the frequency region between these isothermal and adiabatic compression, the heat exchange results in loss of sound energy. This loss is high in fibrous materials if the sound propagates parallel to the plane of fibers and may account up to 40% sound attenuation. So, altogether the reasons for the acoustic energy loss when sound passes through sound absorbing materials are due to:

- Frictional losses
- Momentum losses
- Temperature fluctuations

3.6 APPLICATION OF SOUND ABSORPTIVE MATERIALS

Acoustical material plays a number of roles that are important in acoustic engineering such as the control of room acoustics, industrial noise control, studio acoustics and automotive acoustics. Sound absorptive materials are generally used to counteract the undesirable effects of sound reflection by hard, rigid and interior surfaces and thus help to reduce the reverberant noise levels . They are used as interior lining for apartments, automotives, aircrafts, ducts, enclosures for noise equipments and insulations for appliances . Sound absorptive materials may also be used to control the response of artistic performance spaces to steady and transient sound sources, thereby affecting the character of the aural environment, the intelligibility of unreinforced speech and the quality of unreinforced musical sound . Combining absorptive materials with barriers produces composite products that can be used to lag pipe or provide absorptive curtain assemblies.

Note: All noise control problem starts with the spectra of the emitting source. Therefore, sound absorbing materials are chosen in terms of material types and dimension, and also based on the frequency of sound to be controlled .[17]

3.7 PERFORMANCE OF SOUND ABSORPTIVE MATERIALS

For porous and fibrous materials, acoustic performance is defined by a set of experimentally determined constants namely: absorption co-efficient, reflection co-efficient, acoustic impedance, propagation constant, normal reduction coefficient and transmission loss. There are different methods available to determine these acoustical parameters but all of these methods mainly involve exposing materials to known sound fields and measuring the effect of their presence on the sound field.

The performance of sound absorbing materials in particularly is evaluated by the sound absorption co-efficient (a) [35, 38]. Alpha (a) is defined as the measure of the acoustical energy absorbed by the material upon incidence and is usually expressed as a decimal varying between 0 and 1.0. If 55 percent of the incident sound energy is absorbed, the absorption coefficient of that material is said to be 0.55. A material that absorbs all incident sound waves will have a sound absorption coefficient of 1. The sound absorption coefficient (a) depends on the angle at which the sound wave impinges upon the material and the sound frequency. Values are usually provided in the literature at the standard frequencies of 125, 250, 500, 1000 and 2000 .

The acoustic parameters that need to be considered while studying the acoustical absorptive properties are:

- Sound Reflection Coefficient: Ratio of the amount of total reflected sound intensity to the total incident sound intensity.
- Acoustic Impedance: Ratio of sound pressure acting on the surface of the specimen to the associated particle velocity normal to the surface.

In comparing sound absorbing materials for noise control purposes, the noise reduction co-efficient (NRC) is commonly used. NRC is the average usually stated to the nearest multiple of 0.05, of the co-efficient at four frequencies 250, 500, 1000 and 2000 HZ . It is intended for use as a single number index of the sound absorbing efficiency of a material. This NRC values provides a decent and simple quantification of how well the particular surface will absorb the human voice .

The sound absorption for a sample of material or an object is measured sometimes in sabins or metric sabins. One sabin may be thought of as the absorption of unit area (1 m2 or 1 ft2) of a surface that has an absorption coefficient of 1.0 (100 per cent). When areas are measured in square meters, the term metric sabin is used. The absorption for a surface can be found by multiplying its area by its absorption coefficient. Thus for a material with 24 absorption coefficient of 0.5, 10 sq. ft has a sound absorption of 5 sabins and 100m2 is 50 metric sabins . Harris gives four factors that affect the sound absorption co-efficient. They are:

- Nature of the material itself
- Frequency of the sound
- The angle at which the sound wave strikes the surface of the material

- Air gap

More fundamentally, all sound absorptive materials can be characterized by two basic parameters namely: Characteristic Impedance and Complex Propagation Constant. Characteristic impedance is the measure of wave resistance of air. It is the ratio of sound pressure to particle velocity. Attenuation and phase constant which are included in the propagation constant are the measure of how much sound energy is reduced and the speed of propagation of sound respectively. Even other parameters were tried by researchers in order to include various effects like material internal structure, viscous and thermal loss, which are not discussed here.

3.8 MEASUREMENT OF SOUND ABSOPTION COEFFICIENT

A number of measurement techniques can be used to quantify the sound absorbing behavior of porous materials. In general one is interested in one of the following properties: sound absorption coefficient (a), reflection coefficient (R), or surface impedance (Z). Detailed description of the measurement technique used in this research is given below.[17]

3.8.1 ACOUSTIC MEASUREMENTS

Measurement techniques used to characterize the sound absorptive properties of a material are [75]:

- Reverberant Field Methods
- Impedance Tube Methods
- Steady State Methods

3.8.1.1 Reverberant Field Method

For measuring sound absorption is concerned with the performance of a material exposed to a randomly incident sound wave, which technically occurs when the material is in diffusive field. However creation of a diffusive sound field requires a large and costly reverberation room.
A completely diffuse sound field can be achieved only rarely. Moreover, an accurate value of complex impedance cannot be derived from the absorption coefficient alone Since sound is allowed to strike the material from all directions, the absorption coefficient determined is called random incidence sound absorption coefficient, RAC. This method is clearly explained in ASTM C 423 -- 72.[17]

3.8.1.2 Impedance Tube Method

This method uses plane sound waves that strike the material straight and so the sound absorption coefficient is called normal incidence sound absorption coefficient, NAC . This research uses impedance tube method which is faster and generally reproducible and, in particular, requires relatively small circular samples, either 35 or 100 mm in diameter (according to the type of impedance tube). In the impedance tube method, sound waves are confined within the tube and thus the size of the sample required for test needs only be large enough to fill the cross-section of the tube . Thus this method avoids the need to fabricate large test sample with lateral dimensions several times the acoustical wavelength. The impedance tube method employs two techniques to determine NAC, namely:

1. Movable microphone which is one-third-octave frequencies technique (ASTM C 384) is based on the standing wave ratio principle and uses an audio frequency spectrometer to measure the absorption coefficients at various centre frequencies of the one-third-octave bands.[17]

2. Two-fixed microphone impedance tube or transfer function method (ASTM E 1050), which is relatively recent development. In this technique, a broadband random signal is used as a sound source. The normal incidence absorption coefficients and the impedance ratios of the test materials can be measured much faster and easier compared with the first technique [17].

3.8.1.3 Steady State Method

This method is mostly used when the other will not work. This particular method is described in ASTM E336-71. To measure the transmission coefficient of the materials, a third microphone or even a second pair of microphone can be placed behind the test sample in a second impedance tube.[17]

4. MATERIALS AND METHODS

4.1 INTRODUCTION

This chapter explains the methodologies, materials, evalauation techniques used to study the mechanical properties and sound absorption properties of chicken feather reinforced composites.

4.1.1 OBJECTIVES

The objectives of our project are :

- To collect the chicken feather, separate the fiber and purify them
- To produce the chicken feather fibre and polypropylene blended web
- To develop the sound proof boards using chicken feather reinforced composites
- To study the mechanical and sound absorption properties of chicken feather fibre reinforced composites

4.1.1.1 FIBER COLLECTION,SEPARATION AND PURIFICATION

The chicken feathers from the poultry units are collected and cleaned.the stiff central core of the feather (the quill) must be stripped of the flexible, interconnected strands of material that emerge from it (the barbs).it is only this soft barb material that is useful as feather fiber.

Although the whole feather is made up of keratin, the crystal structure of the protein in the brittle central quill is different from that in the soft but durable barbs; only the barbs have the desirable properties. Then the fibres are strelized in autoclave at high temperature.

4.1.2 WEB PREPARATION

In this project, we have planned to produce the composites using compression moulding technique. in order to produce the composites there are different type of laying technique available.we have selected card laid technique.

4.1.2.1 MIXING

Before the production of web , the first step is mixing where chicken feather fibre (reinforcement) and polypropylene (matrix) are mixed in the ratio of 60:40 respectively.

4.1.2.2 CARDING

After the mixing of fibres (chicken feather fibre and polypropylene), they are fed into the carding machine and the web is produced. In this project we have produced web of 1500 GSM. The webs are produced using the miniature carding machine.(FIG 3.1.2)

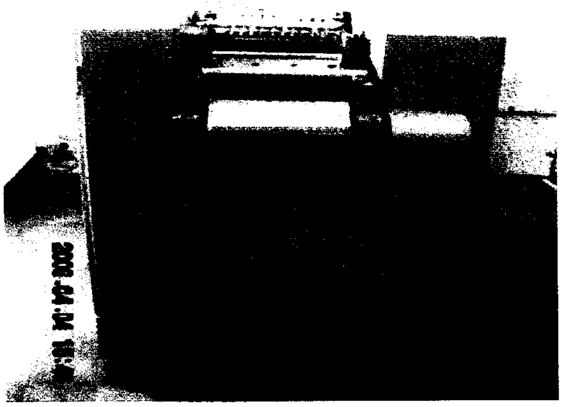
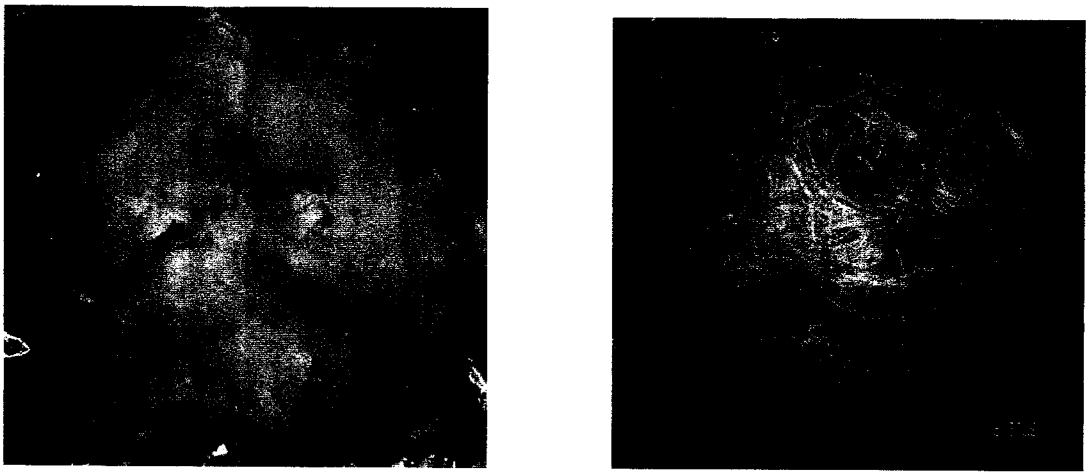
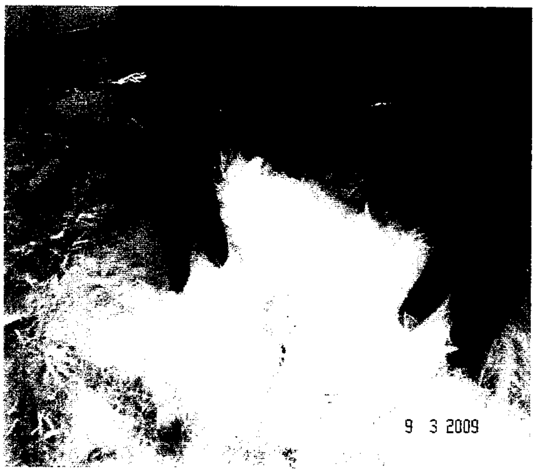


FIG 4.1.2.2 a MINIATURE CARDING MACHINE



POLYPROPYLENE FIBRE (40%) CHICKEN FEATHER FIBER (60%)



MANUAL MIXING OF FIBRES

FIG 4.1.2.2b STEPS IN MIXING

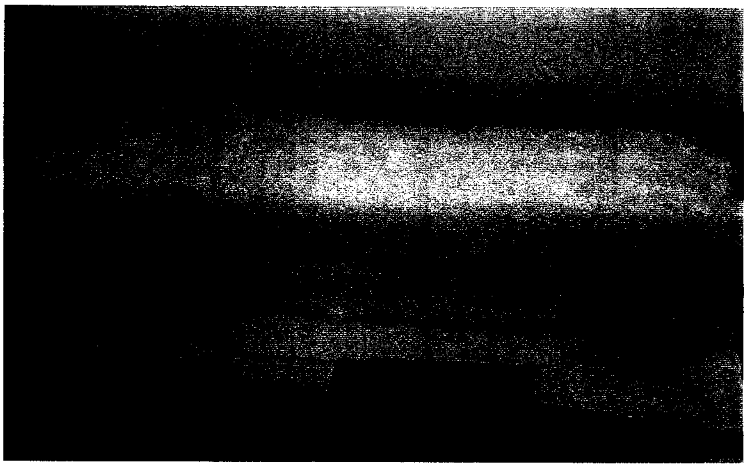


FIG 4.1.2.2c WEB OF 1500 GSM

4.2MANUFACTURE OF CHICKEN FEATHER FIBRE REINFORCED COMPOSITE

Composites are made in the compression moulding machine. The mould was made up of steel of dimensions 15 * 15 * 4 cm and also the samples as well. The chicken feather and polypropylene blended web is cut according to the dimensions of mould and kept on the mould. Then the mould is kept on the compression moulding machine and the composites are produced.(as explained in section 2.8.1)

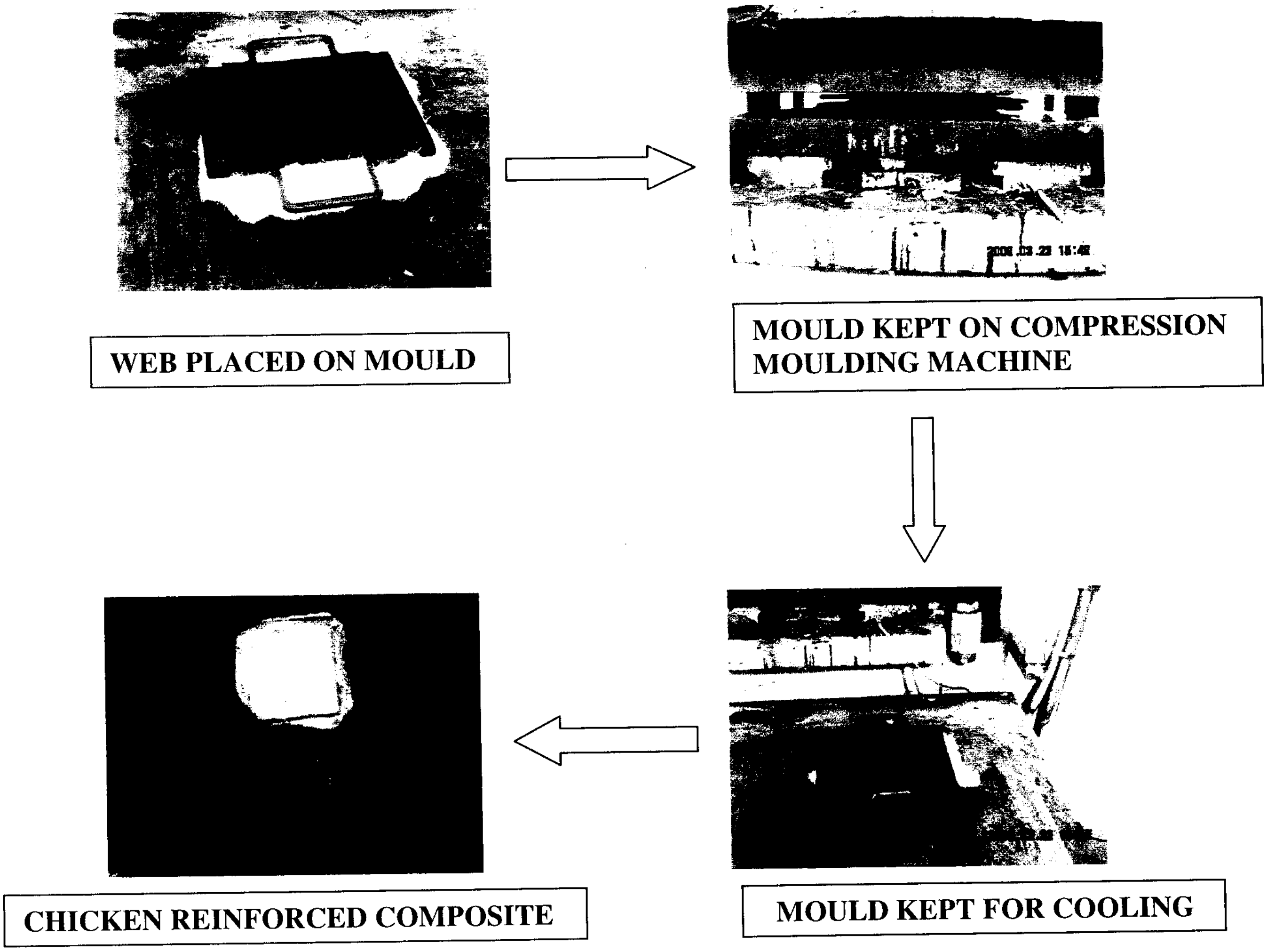


FIG 4.2a Manufacture Of Chicken Feather reinforced composite

4.3 EXPERIMENTAL PLAN

The composites are prepared by varying the process parameters such as

- Temperature
- Pressure
- Time

Table 4.3.1 Experimental Plan

S NO	SAMPLE	TEMPERATURE	PRESSURE	TIME
1	S1	**170°C**	10 BAR	3 MIN
2	S2	**175 °C**	10 BAR	3 MIN
3	S3	**180 °C**	10 BAR	3MIN
4	S4	175 °C	**5 BAR**	3 MIN
5	S5	175 °C	**10 BAR**	3 MIN
6	S6	175 °C	**15 BAR**	3 MIN
7	S7	175 °C	10 BAR	**2 MIN**
8	S8	175 °C	10 BAR	**3 MIN**
9	S9	175 °C	10 BAR	**5 MIN**

Hence 9 different samples are produced by varying the parameters as mentioned in the table

4.4 EVALAUATION TECHNIQUES OF CHICKEN FEATHER FIBER REINFORCED COMPOSITE CHARACTERISTICS

4.4.1 CHARACTERIZATION OF COMPOSITES

The composites fabricated were characterized in terms of the mechanical and sound absorption composites. In order to undergo such processes the following test methods procures the resultant values with respect to the test principles.

4.4.1.1 MECHANICAL PROPERTIES

4.4.1.1.1 FLEXURAL STRENGTH TEST

SCOPE:

Flexural tests provides the strength of material in bending expressed as the stress on the outermost fibres of a bent test specimen at the instant of failure. Flexural test produce a Load(N)-Length(mm) diagram which is used to know the peak load upto which the sample can withstand.this data is often used to specify a material, to design parts to withstand application load and as a quality check of materials.

SAMPLE PREPARATION:

The required sample size for performing flexural strength using UNIVERSAL testing machine is as follows:

- Length =100 mm
- Width=10 mm

TEST PROCEDURE

The test is performed based on the ISO 14 125 1998-03.According to the procedure, the test speed is 50 mm/min. The specimen is placed on the clamps and load will be applied on the specimen. The load will be applied until the sample breaks under bending.

In the computer interface, the graph showing the relation between load and length of the specimen will be displayed.

FIG 4.4a UNIVERSAL FLEXURAL STRENGTH TESTER

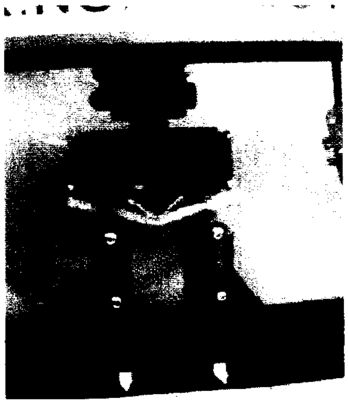


FIG 4.4 b SAMPLE UNDER TEST

DATA:

The following data can be found from the flexural strength testing machine

1. Peak load :
2. % of elongation:

4.4.1.1.2 IMPACT STRENGTH TEST

This test provides the ability of material to withstand shock loading.it is usually tested by charpy impact tester and expressed in terms of joule

SAMPLE PREPARATION:

The samples required for performing impact strength must have the following dimensions :

- Length = 65 mm
- Width = 13 mm

TEST PROCEDURE:

The test is performed based on the ASTM STP 936 1985-08 in the charpy impact strength tester .According to the procedure ,the sample is placed on the sample holder and hammer will be swinged by our hand. The hammer strikes and breaks the specimen and the amount of energy required to break the sample is read from the dial in the instrument.

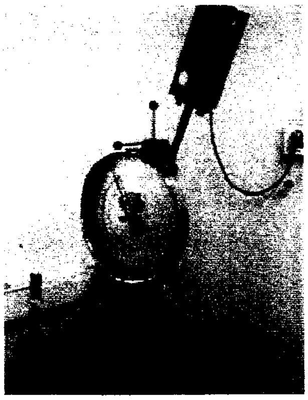


FIG 4.4c CHARPY IMPACT STRENGTH TEST

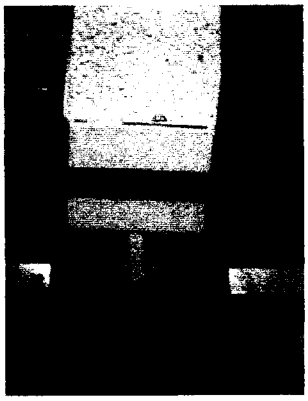


FIG 4.4d SAMPLE FIXED ON SAMPLE HOLDER

DATA:

The following data can be found using carpy impact strength tester

- Impact strength energy :

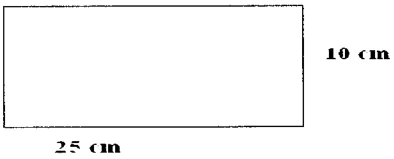
4.5 SOUND ABSORPTION PROPERTY

There are many methods available to test the sound absorption properties of composites. But we have developed our own method of testing the sound absorption property of chicken feather reinforced composites.

TEST PROCEDURE :

To test the sound absorption property, the following method is followed.

Step 1: Construct a rectangular box with dimensions as shown in figure



Step 2: Remove one side of rectangular box to place the source

Step 3: Remove the part which is just opposite to the already removed part to place the specimen

Step 4:Place the rectangular box in the anechoic chamber with non-parallel diffracting material

Step 5: Using the decibel meter measure the ambient sound (without any sound from source)

Step 6:Now place the SOURCE at one side and measure the sound using the decibel meter from the opposite side where the source has been placed. This is noted as **input sound.**

Step 7: now place the specimen and switch on the source and measure the **sound output** from the specimen using decibel meter.

Source placed at one end

(Sound input measurement)

Sound output measured using

decibel meter

FIG 4.5 a STEPS IN SOUND MEASUREMENT

FIG 4.5 b Experimental set-up in a Chamber

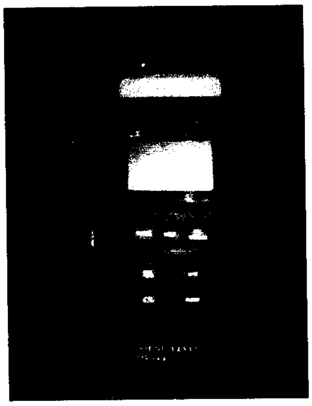


FIG 4.5 c Lutron decibel meter

5. RESULTS AND DISCUSSION

5.1 MECHANICAL PROPERTIES OF COMPOSITE

5.1.1 EVALUATION OF FLEXURAL STRENGTH OF COMPOSITE

The composites were subjected to a Universal flexural strength tester to determine its flexural strength. Results of the study of flexural properties of chicken feather fiber reinforced composite are given in table 4.1.

In the present investigation the reinforcement of chicken feather fiber into Polypropylene has shown good results in terms of mechanical properties. The peak load of the composite is measured to be **7.97** N and its Percentage Elongation at break is determined as **9.98 %.**

Table 5.1.1a Flexural Strength

S.NO	SAMPLE	ISO STD	PEAK LOAD(N)	% OF ELONGATION
1	Sa	ISO 14 125 1998-03	7.6	9.97
2	Sb	ISO 14 125 1998-03	8.2	9.99
3	Sc	ISO 14 125 1998-03	8.1	9.98
		MEAN =	**7.97**	**9.98**

Sa- 100 mm * 9.9 mm * 3.6 mm

Sb- 100 mm * 9.8 mm * 4 mm

Sc- 100 mm * 9.8 mm * 3.8 mm

5.1.2 EVALUATION OF IMPACT STRENGTH OF COMPOSITE

The composites are subjected to Charpy Impact Strength tester to determine the impact strength. Results of the study of impact strength properties of chicken feather reinforced composites are given in the table 4.1.b

In the present investigation, the reinforcement of chicken feather fibres into polypropylene has shown good results in terms of mechanical properties. The impact strength of composite is found to be **0.1 Joule.**

Table 5.1.2.a Impact Strength

S NO	SAMPLE	ASTM STD	IMPACT STRENGTH (J)
1	Sd	ASTM STP 936 1985-08	0.1
2	Se	ASTM STP 936 1985-08	0.1
3	Sf	ASTM STP 936 1985-08	0.1

MEAN = 0.1

Sd-65 mm * 12.8 mm * 4 mm

Se-65 mm * 12.7 mm * 3.8 mm

Sf-65 mm * 12.9 mm * 3.9 mm

5.2. SOUND ABSORPTION PROPERTY

The composites are subjected to sound absorption test in Anechoic chamber with non-parallel sound defracting material. The sound absorbed by the samples is measured using Lutron sound level meter.

The results of sound absorption of composites is tabulated below in Table 5.2.a

Table 5.2.a Sound Absorption Property

S no	SAMPLE	INPUT SOUND (dB)	OUTPUT SOUND (dB)
1	S1	98.3	80.8
2	S2	97.8	78.5
3	S3	98.2	77.5
4	S4	97.9	75.3
5	S5	98	77.2
6	S6	98.1	80.2
7	S7	98	80.3
8	S8	98.2	79.8
9	S9	98.3	77.8

S1-**170°C**,10 BAR,3 MIN

S2-**175 °C**,10 BAR,3 MIN

S3-**180 °C**,10 BAR, 3MIN

S4-175 °C**, 5 BAR**, 3 MIN

S5-175 °C,**10 BAR**,3 MIN

S6-175 °C, **15 BAR**,3 MIN

S7-175 °C,10 BAR,**2 MIN**

S8-175 °C,10 BAR,**3 MIN**

S9-175 °C,10 BAR,**5 MIN**

5.2.1 EFFECT OF TEMPERATURE ON SOUND ABSORPTION PROPERTY

From table 5.2.1, the following graph showing the graph between temperature and sound output from the samples is plotted.

FIG 5.2.1 a GRAPH BETWEEN TEMPERATURE & SOUND OUTPUT

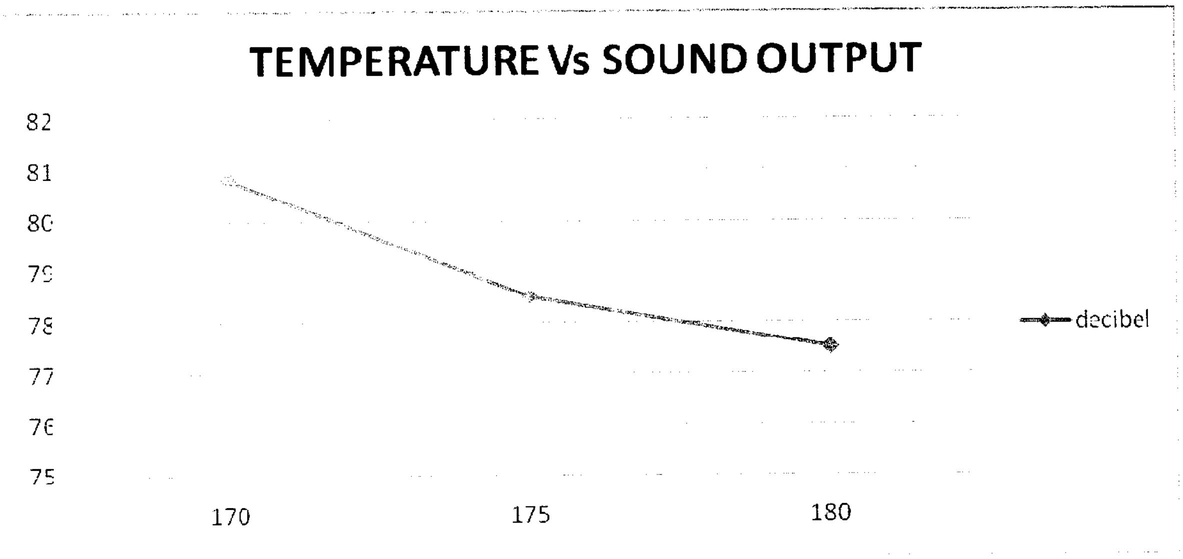


TABLE 5.2.1 TEMPERATURE VS SOUND OUTPUT

S NO	TEMPERATURE (°C)	SOUND OUTPUT(dB)
1	170	80.8
2	175	78.5
3	180	77.5

INFERENCE

As the temperature is increased from 170 °c to 180 °c, the sound output is gradually reduced. This may be due to the fact that bonding between chicken feather fibre and polypropylene fibre increases as the temperature increases.

5.2. 2 EFFECT OF PRESSURE ON SOUND ABSORPTION PROPERTY

From table 4.2, the following graph showing the relation between pressure and sound output from the composites is obtained.

FIG 5.2.2 a GRAPH BETWEEN PRESSURE & SOUND OUTPUT

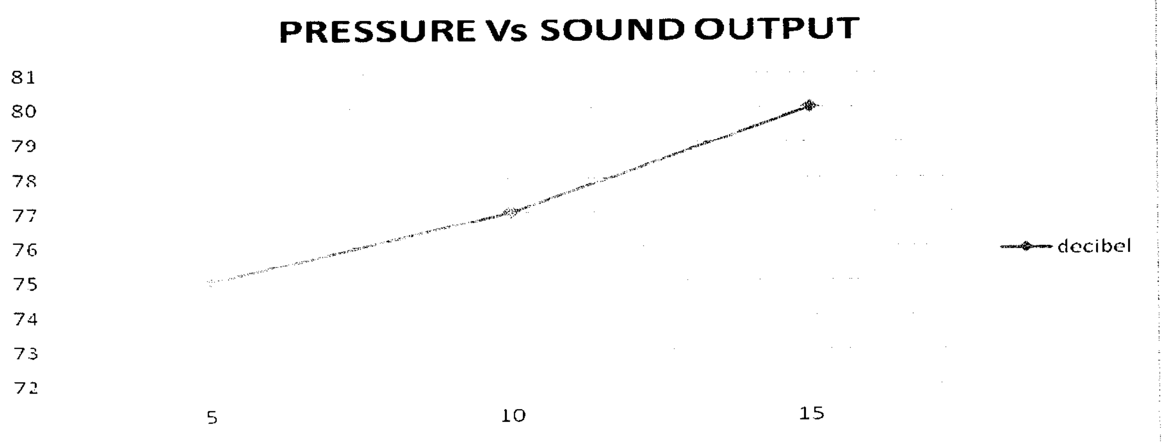


TABLE 5.2.2 PRESSURE VS SOUND OUTPUT

S NO	PRESSURE (BAR)	SOUND OUTPUT(dB)
1	5	75.3
2	10	77.2
3	15	80.3

INFERENCE

As the pressure increases from 5 bar to 15 bar, the sound output from the composites also get increased. This may be due to the fact that as the pressure increases the thickness of composite get decreased.(It is already proved that as the thickness increases sound absorption also increases-Ching-wen lou –TRJ-2005)

5.2.3 EFFECT OF TIME ON SOUND ABSORPTION PROPERTY

From table 4.2, the following graph showing the relation between time and sound output is plotted.

FIG 5.2.3. a GRAPH BETWEEN TIME & SOUND OUTPUT

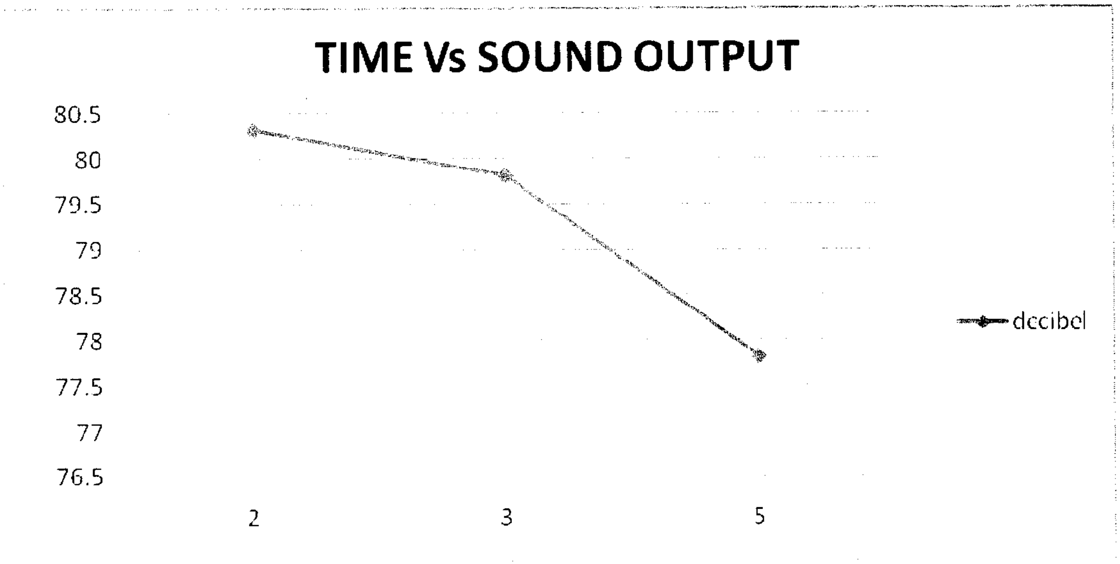


TABLE 5.2.3 TIME VS SOUND OUTPUT

S NO	TIME (MIN)	SOUND OUTPUT(dB)
1	2	80.3
2	3	79.8
3	5	77.8

INFERENCE

As the time is increased from 2 min to 5 min , the sound output is gradually reduced. This may be due to the fact that bonding between chicken feather fibre and polypropylene fibre increases as the time increases.

6. CONCLUSION

The chicken feather fiber reinforced composite were successfully manufactured by analyzing the Chicken feather fiber properties. The mechanical and sound absorption properties of the chicken feather fiber reinforced composites were determined.

The test results show that the composites posses good sound absorption property and it can able to reduce 15 to 20 decibel.

From the test results it is found that:

Excellent absorption : S4
Good absorption : S3, S4, S9
Average absorption : S2
Poor absorption : S1, S6, S7, S8

Hence we conclude that chicken feather reinforced composite can be used as a sound proof board.

7. FUTURE SCOPE OF THE PROJECT

1. The proportion of chicken feather fibre and polypropylene fibre can be varied to produce the composites and the sound absorption can be studied.
2. The different application areas of this composite can be identified.
3. The reinforcement can be used as nonwoven, woven and knitted fabric.
4. The composites may be produced by using different matrix such as polyethylene.

8. REFERENCES

1. Associated Press, "Researchers Study Plastics from Feathers", Associated Press Online, 23 September 2004

2. Besso, M, "New Composites Offer Opportunities: Combining Natural Materials Can Help People and the Environment", News Journal, 29 September 2003

3. Dipa Ray, B.K.Sarkar, A.K.Rana and N.R.Bose. "Effect of alkali treated jute fibers on composite properties", vol-24, No-2, April 2001, page-129 to 135.

4. FG. Torres, ML. Cubillas, "Study of the interfacial properties of natural fiber reinforced polyethylene", *Polym. Test.* **24**, pp.694–8 2005.

5. George, B.R., Bockarie, A., McBride, H., Hoppy, D., Scutti, A. (2003a). Utilization of turkey feather fibers in non-woven erosion control fabrics. *International Non-wovens Journal*, Summer 2003: 45-52.

6. Halford, B, "Going Beyond Feather Dusters", Chemical and Engineering News, 82, 36, 06 September 2004, 36-39.

7. Hong, C.K., Wool, R.P. (2005). Development of Bio-Based Composite Materials from Soybean Oil and Keratin Fibers. *Journal of Applied Polymer Science*, 95: 1524-1538.

8. Jacobson, L, "Can Computers Fly on the Wings of a Chicken?", Washington Post, 08 July 2002

9. Jeffrey W. Kock, "Physical And Mechanical Properties of Chicken Feather Materials", MS Thesis, School of Civil and Environmental Engineering, Georgia Institute of Technology , May -2006.

McGovern, Victoria (2000). "Recycling Poultry Feathers: More Bang For The Cluck" *Environmental Health Perspectives*, August

10. Ruta Roy, B.K.Sarkar, A.K.Rann and N.R.Bose,"Impact fatigue behaviour of carbon fiber-reinforced vinylester resin composites". Bull.Master.Sci, vol-24, No.1, February 2001, page-79 to 86.

11. W.F.Schmidt, "Innovative Feather Utilization Strategies", National Poultry Waste Management Symposium Proceedings, 1998.

12. www.chem.iitm.ac.in

13. www.sitra.org.in

14. www.cusat.ac.in

15. www.cipet.india.com

16. Yan Li, Chunjing Hu, Yehong Yu, "Interfacial studies of sisal fiber reinforced high density polyethylene (HDPE) composites", *Composites Part.* 2007 (in press)

17.Kannan Allampalayam Jayaraman, "Acoustical Absorptive Properties **of** Nonwovens", under the guidance of (Dr. P. Banks-Lee and Dr. B. Pourdeyhimi).

18.Kuan-Hua Su, Jia-Horng Lin, Zheng-Hong Liu, Ching-Wen Lou ,

"Recycling polyester and polypropylene nonwoven Selvages to produce functional sound absorption Composites",Textile Research Journal, March 2005

19. www.noisestop.com

20. www.composites.com