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Development of Composite Material for HVAC System

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Abstract - *Contamination because of plastic waste is a significant worry for the eco-accommodating climate. These artificial waste delivery different poisons to the climate, which are hurtful to humanity. To experience the impact of the manufactured materials, bio fiber based polymer composites produced using bio filaments (jute, hemp, flax, cotton and so on) are arising as a reasonable substitution as bio fiber based polymer composites are minimal expense, light in weight and eco-accommodating.*

The fascination on the bio-composite (known as green composites) materials has altogether expanded because of the capability of being substitute to customary materials utilized in assembling industries. In late days, specialists, architects and researchers are drawn in towards the utilization of normal filaments in the assembling of composites due to their minimal expense, bountiful, sustainable, better formability and eco-accommodating provisions. The composites materials are made with prevalent characteristics, which makes things fitting for warming, ventilation and cooling (HVAC) applications. Cooling systems in the past were customarily made of metal. In any case, thermoset composites offer more prominent strength, longer future, greater warmth hindrance and more grounded disintegration resistance. Since, the thermoset composites are development protected, there is less chance of shape making. This gives cleaner air in the affected districts. Decreases the regular impact of our industry which empowers natural change, and impacts the sufficiency of millions of people. Another huge piece of cooling foundation is expected for business, mechanical, private and clinical construction or clinical facilities. A couple of essentials that success instead of business cooling apply to crisis facility, yet there are some of additional concerns moreover. In exceptional cases, like action theater, ventilation necessities consistently decide the usage of 100% outdoors and sogginess cutoff focuses may be more genuine in working rooms. The arrangement of an energy capable structure for a facility that in like manner meets the remarkable essentials of a planning troubles.

Key Words: **Biocomposite, Green Technologies, Environment friendly, HVAC, Sustainability, Thermoset Composites.**

INTRODUCTION

The acquaintance of new items with the market is basic to an organization's development (Fahy and Jobber, 2012). There is an objective in the European Union (EU) to support imagination, and there are numerous guidelines set up that impact each period of the advancement cycle. Composites made out of thermoset and bio composites are by and large made of epoxy or polyester saps and built up most oftentimes with glass filaments. The gentler and more adaptable, or harder and more delicate polyester gum frameworks might be mended according to application. Composites are used all through a wide scope of shopper and business things, from washroom showers to auto body boards and electrical gear. Thermoset composites track down another home in the HVAC area, supplanting segments that have recently been overwhelmed by the utilization of metal components. A long time back, generally metal parts were made by warming and cooling. Aluminum, treated steel, lightweight measure steel and covered metal were passed on delicate to rust, erosion, and sun harm while extremely impressive as a material. The interest in a material change of HVAC framework parts into composites is driven by non-combustibility and electrical conductivity prerequisites. Composites give the chance to consolidate parts, lower commotion levels, and upgrade different functionalities notwithstanding the exhibition advantages.A regular composite or organic composite is a composite that began from plants, creatures, and human sources [1], [2]. The use of bio-composite materials in furniture fabricating is another thing in the business. Biocomposite materials that are gotten from regular and inexhaustible sources have gotten huge interest lately, specifically, because of the expanded attention to and drive towards all the more ecologically supportable advances. In this task, biocomposite materials that have great mechanical properties like high strength, lightweight, low thickness, and high adaptability just as stylishly satisfying are accustomed to assembling a little piece of the framework.

Sugar palm fiber (SPF) is a characteristic fiber got from Arenga pinnata tree. [3], [4]. This plant is standing out enough to be noticed lately as a result of its capacity in giving great sap to the creation of liquor fuel [5]. Furthermore, the support of a tar framework with sugar palm strands brought about a composite with great strength and unbending nature [6], [7]

HVAC Thermoset Composite Materials offer :

• Longer life expectancy – The longer, much more than 10 years or longer endurance of a composite part of a thermoset.

• Hot strength: replacement of metal parts with materials that can endure higher temperatures without decomposition, melting or combustion

• Endurance - Component requirements in this sector are severe and need more durability than other sectors.

• Corrosive and condensation- Resistant composites in thermosets are often found in their metallic components and resistant to corrosion.

Thermoset With in HVAC Composite Applications

Embracing thermoset composite material parts in HVAC isn't a "tear and supplant" arrangement. Thermosets are great for new development, part and segment redesigns, and retrofitting applications. Due to the lightweight idea of thermosets, use in business applications is ideal as it can regularly refute the requirement for customary weighty hardware needed to move cumbersome metal pieces.

Thermoset composite material HVAC components include:

- Air Conditioning Housing
- Blowers
- Condensing Unit Components
- Exhaust
- Vents

LITERATURE REVIEW

As of late, notwithstanding, the proficient and prudent plan of building is turning out to be progressively fundamental taking into account the use of biocomposites materials, thermoset composites, energy emergencies and the assimilation and cogeneration framework. Kazachki et. al and others tracked down that circuitous cooling frameworks cost 30% more and are utilizing 30% more force in auxiliary frameworks. This was on the grounds that the optional coolant (saline solution) had helpless bottle actual qualities and in light of the fact that the structure strategies used in the underlying execution were blemished. In mix with cutting edge designing strategies over late many years, the utilization of improved optionally coolants dependent on natural salt water arrangements has permitted auxiliary coolant innovation to contend viably with traditional DX frameworks (direct extension), both for introduced costing and energy use. Kavanaugh et.al considered the Building cooling and warming rules for the essential temperature zones were explored. He determined warmth gain and warmth misfortune for structures that pre-owned energy-productive envelopes, protection, machines, and ventilation [7].

Douglas et al. [5] has found in non-bone-dry areas that an increment in external air volume will prompt multiple times the degree of inside dampness. A few reports have been made of the hurtful impact on people and homes of high mugginess. Douglas et al. [5] has found in non-bone-dry locales that an expansion in external air volume will prompt multiple times the degree of inside dampness. A few reports have been made of the hurtful impact on people and homes of high dampness. In wet circumstances, this standards is best rehearsed to stay away from issues which happen at more prominent dampness levels.

The following major parameters have been recognized as having a substantial influence on HVAC configuration performance:

1) The ability to minimize external air load by reducing both external air mass flow rates and external air temperature.

(2) Entrap difference between external air and exhaust air can be eliminated.

(3) The capability of simultaneously using free cooling and cooling.

(4) Inter-zonal pathways for air circulation Systems that satisfy these standards can deliver the desired air quality and reduce energy consumption.

The efficiency of an HVAC system or device and the requirement for HVAC management are two elements which can have an impact on a building's energy use. Reviews Building energy legislation has been utilized to assess the HVAC system's energy demands. Air conditioning and cooling Equipment efficiency and HVAC specified the preconditions were two important themes in the prescriptive HVAC.

TABLE I

MECHANICAL PROPERTIES OF NATURAL FIBER AND SYNTHETIC FIBERS [8]

Type	Fiber	Density (g/cm^2)	Tensile Strength (MPa)	Elastic Modulus (GPa)
GRASS	Bagasse	1.2-1.25	20-290	17-27.1 1.1
FRUIT	Coir	1.15-1.45	106-593	1.27-6.0
BAST (STEM	Flax	1.4-1.5	345-1500	27.6-80
WOOD	Hard Wood	0.3-0.88	51-210.7	5.2-15.6

LEAF	Abaca	1.5	400-980	3-12
SEED	Cotton	1.5-1.6	287-597	5.5-12.6
SYNTHETIC	Carbon	1.4	4000	23-240
SYNTHETIC	Ramie	1.55	400-938	61.4-128
Natural	Sisal	1.45	468-1627	34.5-82.5

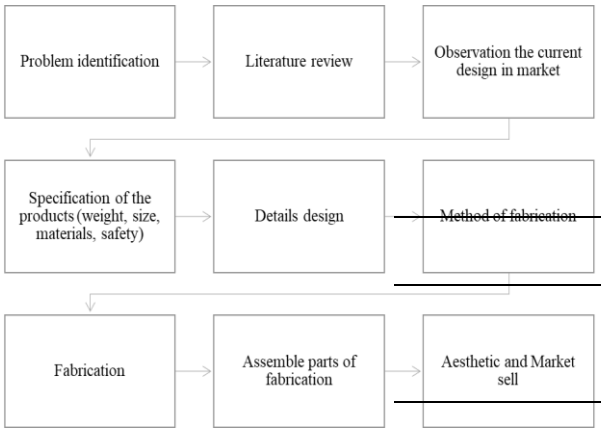

Figure 1: Overall methodology of this study

Market study

Biocomposite HVAC framework is another creation in business industry. Henceforth, some investigation is required in the execution of this task. The plans of existing framework were accumulated from HVAC engineers, web sources and lists. The example, materials, handling cost and procedure were distinguished in past examination (embed reference). In this examination, a few enhancements are made in the plans and materials to work on the strength and lessening the heaviness of the table other than making the general creation measure greener through the usage of plant-based bio-composite materials.

Wood is attractive over metal for diminishing the heaviness of the table, in any case, wood can't stand soggy condition and usually ingests the water. This is certainly not a decent component for new framework for long haul use. To defeat the limits of existing HVAC framework, a biocomposite-based framework from Natural fiber was manufactured in this examination. Polyester tar utilized has great trademark, incorporates high strength and water opposition. Blend among SPF and this tar has brought about an extraordinary nature of table to contend the market request [9]

Product design specification

In view of the market study, a few upgrades of the current HVAC framework ought to be considered in the creation of this bio-composite-based, like weight, size, joining and so forth From the investigation, a portion of the details; weight, size, cost, security, amount and tasteful qualities were made before the creation cycle.

Research Methodology

The design process was performed using the total design activities from identification of the market needs up to the satisfying the customer needs with eco-environment. The selected design will be fabricated with Natural fiber composites at the same times make the table have a great view, joining, and strength. Figure 1 shows the overall flow of the methodology.

Table 2 shows the aspects and specifications of the fabricated bio-composite parts of Biocomposites HVAC system.

Aspects	Specification
Performances	Able to load at least four cup of coffee The top plate must not absorb any spilled
Weight	Weight should not exceed 5-10 kg
Size	Easy to move Can fit small space (40 cm x 40 cm) size
Cost	Less than Rs 4000 Suitable to compete the market price
Safety	Have safety edges Can load below than 10 kg
Quantity	One unit
Aesthetics	Attractive colour A fit joining Good finishing

Mould development

Preceding Biocomposites HVAC manufacture, the boundaries of the framework were characterized. In this work, the manual hand lay-up measure was picked in light of the fact that table manufacture simply require an immediate manufacture techniques was chosen to create an incredible item. There are numerous accessible techniques in composites producing, which are manual lay-up, mechanized lay-up, splash up, fiber winding, pultrusion and tar move

forming [10]. Of the relative multitude of approaches, the most straightforward one is the hand lay-up measure, which includes direct emptying of tar into that piece of form for creation reason.

This strategy is reasonable for creating composites results of wide scope of sizes that can be manufactured from open embellishment procedure.

Fabrication process

Before performing the lay-up process, some of the materials and equipments were prepared such as wax, release anti-adhesive agent, gel coat, iron roller, a container, resin and hardener.

The procedures of hand lay-up process are as follows:

1. The mould was coated by a release anti-adhesive agent for preventing sticking of the mould part to the mould surface.
2. The gel coating was applied to prime surface layer to improve the appearance of the finished product by creating shiny surface.
3. A layer of matrix and fibres were applied into the mould.

Calculation for resin and hardener

The volume of resin and hardener were based on their weight (gram). The calculation below shows the ratio of the

Volume of resin and hardener depend on the type of the resin used, in this case is polyester resin. resin and hardener needed for the top part and leg part.

The ratio of resin to hardener is 4:1. Total ratio = 4 + 1= 5. Figure 7 shows the drawing and parameters of the top plate part. The width and length of the part is 400 mm. The thickness of the top plate is 16 mm.

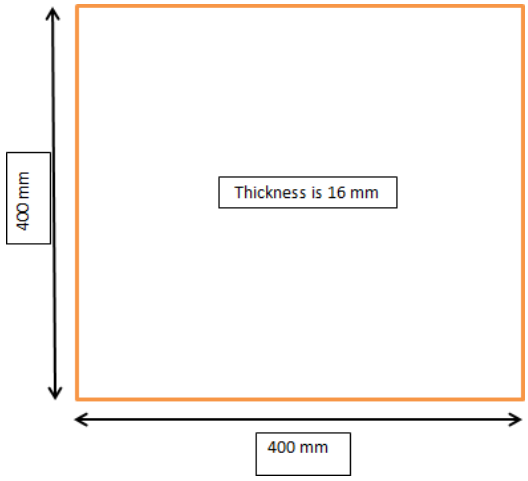

Figure 2: The drawing and parameter for sample plate mo

Calculation of resin weight for ta sample plate used in HVAC system

The weight of the resin was calculated from the volume, density and the ratio between resin and hardener. This value depends on the density and type of resin and hardener. The calculation below shows the weight of resin and hardener needed for a complete fabrication of top plate part.

- Volume of specimen,

  V = Width x Length x thickness

  = 40 cm x 40 cm x T cm

  = 1600T cm^3

  T is the thickness of the layer to be laminated. In this lay-up process, thickness for each layer was set to be 4 mm, 8 mm, and 4 mm, respectively for 1st, 2nd and 3rd layer, to give overall thickness of the top plate component to 16 mm as shown in Figure 2.

- Weight of resin for (T = 4), W = Volume of specimen x density x ratio for resin
- = 1600 (0.4) x 1.15 x (4/5)

  = 588.8 gram
- Weight of hardener, W = Weight of matrix X ratio for hardener = 588.8 x (1/5)
- = 117.76 gram
- Fiber weight used for top plate is 100 gram (two layers).
- Total weight

  Total weight for top plate = Weight resin + weight hardener + fiber weight Total weight for top plate

  = 588.8 gram + 117.76 gram + 100 gram

  Total weight for top plate = 806.56 gram

  The total weight of the top plate part is 806.56 gram.
- Total weight

Total weight for top plate = Weight resin + weight hardener + fiber weight

Total weight for top plate = 194.3 gram + 38.9 gram + 40 gram

Total weight for top plate = 273.2 gram

The total weight of the leg part is 273.2 gram.

CONCLUSIONS

All in all, this investigation was effectively performed to create a little piece of Bio-based HVAC-framework from sugar palm filaments (SPF), following the primary destinations to save our current circumstance with satisfy clients' requests moreover. A lightweight, solid and high aesthetical worth part was manufactured utilizing pressure of SPF and tar blend and more prudent because of decrease in measure of tar utilized in the creation. Be that as it may, the normal fiber composite is another kind of material in HVAC industry. Consequently, further examination on the gear readiness, composite creation and parts gathering ought to be made to work on the quality and aesthetical worth of the manufacture item. The current investigation analyzes the utilization of Biomaterials in the calculation of cooling loads with high strength for HVAC frameworks and advancement of PC helped configuration, just as programming improvement. Bio-based HVAC framework are utilized to make with the assistance of sugar palm fibe rs and a few polymers to use for support or to upgrade the properties of Bio-based little piece of a framework as an elite material. The colossal benefits of biocomposites, like bounty, light weight, biodegradability, a few other inborn properties, and ideal properties contrasted and metallic materials or some other kinds of materials.

Bio composite is the Future of the HVAC Industry

The capacity to speed up advances without influencing people in the future has gotten especially pertinent because of globalization. For North American organizations looking for worldwide development in the coming years, having the option to sell sustainable power choices and eco-accommodating items at reasonable costs would be basic to showcase entrance. Considering that objective, Annex air accepts that this creative plan of action is basic and significant for Canada and the United States to accomplish their ozone depleting substance discharge objectives. Truly, the progression of inexhaustible and greener innovation. Perceiving the need to move to all the more agreeable items and bundling strategies, they began to view at elective materials as an approach to all the more likely limit our regular waste. They considered Bio composite, which is normally made of regular pitches and plant filaments however can likewise be made of reused plastic containers.

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