

Evaluation of Radiation Characteristic of Plastic Reinforced Polymer Composite

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Abstract— In this work, the non recyclable plastics are to be used as reinforcement with resins as a matrix. This composite uses the waste plastics to be converted into useful products that can replace asbestos and metal sheets used for roofing applications. By this the life of the waste plastics is extended as a useful product on earth and the consumption of metals and asbestos can be reduced. Also this can be a good solution for converting waste plastics into useful products without any toxic emissions and green house gases which are the main sources of air pollution. The plastic wastes are collected and made into a composite using polyester resin. After curing, the composite is subjected to various characterization studies such as percentage light intensity, temperature and relative humidity and found that it performs well under the climatic conditions and proves that it can be an alternate for roofing materials such as asbestos and metal sheets. These characterization studies are carried out through an Arduino processor which is connected with various sensors and a computer to interpret the results [1][2]. It also shows better characteristics than the traditionally used roofing materials such as asbestos and metal sheets and proves to be low cost composite for this application.

Keywords—Toxic emissions; green house gases; percentage light intensity; arduino processor; sensors.

I. INTRODUCTION

Plastic is a material consisting of wide range of synthetic or semi- synthetic organics. Thermoplastics do not undergo any chemical change in their composition when heated and can be molded many times. Examples include: polypropylene, polystyrene and polyvinylchloride.

Thermosets can be melted and shaped once and they cannot be melted again. In the thermosetting process, a chemical reaction occurs that is irreversible. The vast majority of the polymers are based on chains of carbon atoms alone or with oxygen, sulphur, or nitrogen as well. Mostly the thermoplastics are recyclable, while thermosetting plastics cannot be recycled. The properties of plastics which affect the environment are as follows:

It has very slow rate of degradation, it takes 500 to 600 years to decompose based on the type of plastic. Since its degradation rate is much slower, the plastic waste thrown to the land will block the water passages, drainage and it will not allow the rain water to penetrate inside the ground. If we burn the plastics, it will release enormous amount of toxic gases like nitrogen oxides, sulphur dioxide, volatile organic chemicals, polycyclic organic matter (POMs - a solid residue leftover), dioxin, carbon monoxide, carbon di oxide, etc. If human inhale dioxin or to be exposed to its fumes can cause cancer, impotence, asthma, allergies and even death.

Plastic waste can also impose negative effects such as greenhouse gas emissions or ecological damage. It also affects the water bodies like, rivers, lakes, ponds, seas and oceans and affects the species living in that. During recycling the plastics should be sorted out very carefully, since mixing of plastics make them non recyclable next time and the plastics after separation, gets melted and then extruded and pelletized to make another new product which also needs energy. So the eco friendly way is to reuse the plastics. Mostly the non recyclable plastics such as BPA (Bisphenol A), polycarbonate, polystyrene, polyvinyl chloride (more toxic), polylactide, nylon, butadiene, styrene which are used to make water pipes, insulation, clothing, furniture, toys, packaging foams, drinking cups, DVDs, frames, water bottle caps, water cans, etc are taken for reinforcement.

II. TESTING FOR RADIATION

A. Testing equipment- Arduino processor

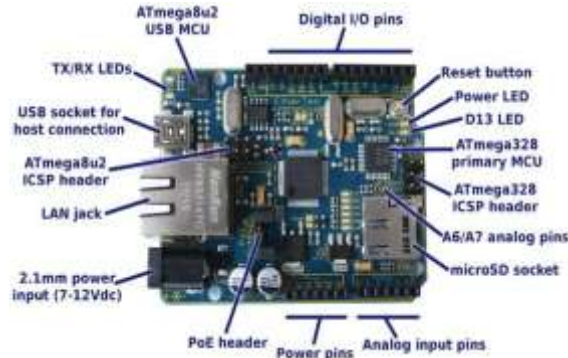


Fig. 1. Arduino Processor

The Arduino integrated development environment is a cross-platform application written in Java. Arduino boards are relatively of low cost compared to other microcontrollers. The Arduino modules can be assembled by hand. The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. The programs are very simple and clear. The Arduino Software (IDE) is easy to use for beginners.

The Arduino software is available as open source tools. This language can also be expanded through C++ libraries. A Common license is provided for Arduino boards and softwares, if needed experienced circuit designers can make their own version of the module, extending and improving it.

B. Arduino Software

Arduino programs can be written in any programming language with a compiler that produces binary machine code. The Arduino project provides the Arduino IDE, which is a cross-platform application written in the programming language Java. It is designed to introduce programming to artists and other newcomers unfamiliar to this software. A program written with the IDE for Arduino is known as "sketch".

The Arduino IDE also supports C and C++ languages using special rules to organize code. The Arduino IDE has a software library called wiring, which provides many common input and output procedures and programs.

After compiling and linking with the GNU tool chain, also included with the IDE distribution, the Arduino IDE employs the program to convert the executable code into a text file in hexadecimal coding that is loaded onto a Arduino board by a loader program.

III. FABRICATION METHOD

A. Test setup

Before carrying out the weather testing in the composite, the test setup to conduct the test is to be fabricated. It is a prototype model of a home made of wood with the roof part that can be dismantled separately. The arduino processor and the sensors is placed inside the setup to get the accurate readings. The top portion of the setup is initially a piece of wood which can be replaced by any other materials such as asbestos, the prepared polymer composite and metal sheet and the readings are to be taken. Figure 2 shows how the processor is placed inside the setup. The test setup is portable and can be carried anywhere to carryout the tests.



Fig. 2. Test setup with Arduino Processor

IV. CONDUCTION OF TESTS

The test setup is placed with sensors connected to the processor which is placed inside the setup and the Arduino processor is connected to the computer to record the readings. The materials to be tested by replacing the top portion of the setup are asbestos, metals sheet and the polymer composite. The reading which are to be noted are the light intensity transfer [3], temperature transfer [4] and humidity [5] through the roof with different materials. The readings are taken at regular intervals in a day with half an hour interval gap and its average is taken. The total day is divided into four parts as morning, noon, evening and night. The tests were conducted for a time period of 6 months and the average readings were tabulated in the forth coming tabular columns.



Fig. 3. Test setup with Composite



Fig. 4. Test setup with Asbestos



Fig. 5. Test setup with Metal sheet

V. RESULTS AND DISCUSSION

A. Light intensity / Illuminance

The light intensity measurement is possible by using BH 1750 sensor. The sensor has a built in 16 bit AD converter which can directly provides a digital signal; there is no need for complicated calculations. The data output provided by this sensor is in Lux (Lx). The BH 1750 sensor can be directly connected to the arduino processor through jump wires and the suitable program is downloaded and fed into the processor by connecting the processor to a computer. The sensor should be kept in the place where the light intensity has to be measured and the processor will display the readings in a lcd display in units of Lux ($1\text{Lm}/\text{m}^2$).

Table I. Light intensity readings

Timing of tests	Light intensity/ Illuminance readings (Lux)			
	Composite	Asbestos	Steel sheet	Best results
Morning	310	95	90	Composite
Noon	552	150	130	Composite
Evening	250	50	40	Composite
Night	1	0.1	0.02	Composite

From the above table it is clear that the fabricated composite has more light intensity transfer than other roofing materials like asbestos and metal sheets. So it can be used in both homes and industries domestic usage for roof lightning purposes which can transfer more light which is needed during day time, so that the usage of lights in daytime can be avoided.

B. Temperature measurement

The temperature measurement is taken through DHT 11 sensor which converts the heat energy into electrical signals and the processor gives out the desired output in degree Celsius. The sensor should be placed in a place where the temperature has to be measured and the processor should be connected with a computer. The readings can be viewed in a lcd screen connected with processor.

Table II. Average outdoor Temperature readings

Timing of tests	Average outdoor Temperature reading (°C)
Morning (6am – 11am)	30
Noon (11am – 4pm)	37
Evening (4pm – 6pm)	32
Night (6pm – 8pm)	29

Table III. Temperature readings

Timing of tests	Temperature readings (°C)			
	Composite	Asbestos	Steel sheet	Best results
Morning	27	28	29	Composite
Noon	33	35	36	Composite
Evening	29	30	32	Composite
Night	26	27	27	Composite

From the table 3 it can be concluded that the polymer composite shows good temperature characteristics than other roofing materials. It has good insulation property than other material so it transfers low heat than other materials. So it is suitable for roofing applications.

C. Humidity measurement

The humidity measurement is also taken through DHT 11 sensor which measures the relative humidity of a place and gives out the desired percentage. The sensor should be placed in a place where the humidity has to be measured and the processor should be connected with a computer. The readings can be viewed in a lcd screen connected with processor.

Table IV. Humidity readings

Timing of tests	Humidity readings (%)			
	Composite	Asbestos	Steel sheet	Best results
Morning	42	45	45	Composite
Noon	35	38	40	Composite
Evening	40	54	48	Composite
Night	40	50	48	Composite

From table 4 it is clear that the humidity (moisture) which passes through the composite is very less when compared to that of other roofing materials. It shows good results at all parts of the day. Thus the three tests with three materials were conducted using the test setup and the readings are tabulated in table 1, 3 and 4. The table readings clearly indicate that the polymer composite is showing good roofing properties when compared to that of the other materials such as asbestos and metal sheets. It shows better properties at all the parts of the day and proves to be a good roofing material.

VI. CONCLUSION

Thus a new plastic reinforced composite is successfully fabricated and tested for roofing application and found to be suitable for the application. It also shows better properties than other roofing materials used such as asbestos and metal sheets at all times in a day. Thus this project aim is achieved by converting the waste plastics into useful products and that can also be used as a roofing material for domestic and industrial usage. The composite is in testing for its strength, flexural properties and hardness properties.

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