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Recycled polypropylene Tiles: - From waste to wealth

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Abstract— The main objective of this research work is the development of multipurpose light weight polypropylene (PP) tiles by injection moulding technique from recycled polypropylene. The base material selected for this product is polypropylene (PP) which is a common thermoplastic commodity plastic having melting point of 140°C. PP is a polymer material that offers good quality of elasticity, toughness, high mechanical strength with great aesthetic properties. Various compositions of recycled PP composite along with PP copolymer and acrylo butadiene styrene (ABS) have been formulated. These recycled composite materials have been processed by an injection molding machine to tiles and characterized for various properties to confirm its feasibility for commercial application. PP tiles having PP copolymer and ABS shows highest value to tensile strength i.e. 36.2 N/mm2. These tiles can be used as a better substitute in order to replace conventional tiles and can also resolves plastic land filling problem.

Keywords: Polypropylene, recycling, acrylo butadiene styrene, mechanical strength.

I.INTRODUCTION

Today is the age of plastics. The plastics products are used to such a large extent that we are living in the soup of plastic. Everybody has adopted use and throw lifestyle without thinking its proper disposal. Plastics being non-biodegradable take years to decompose and causes problem of land filling and soil pollution. The adverse effect associated with the surge in uses of non- biodegradable plastic products include the blockage of drains, suffocating some animal life, who accidentally take them as food, grounds impermeable to water and several other hazards. Plastics cannot be avoided but can be recycled into useful products. In years past, various works have been done on recycling of plastic wastes by many researchers. Owing to the rapid upsurge in the price of building materials, a young man from Kodungallur, in Thrissur district (Kerala) in India devised a way of making floor tiles from plastic waste. This type of tiles is seen to have numerous advantages over conventional cement tiles [1]. A large amount of work has already been done on Polyethylene (PE) of various grades. Polypropylene (PP) has been chosen due to its properties which lie between that of LDPE and HDPE [2]. It is Semi-rigid, translucent plastic having low density (0.9 gm/cc), high crystalline, good chemical resistance, good fatigue resistance, integral hinge property, good heat resistance [3, 4]. To further improve properties, combination of recycled PP with PP copolymer and acrylo butadiene styrene (ABS) has been formulated.

II. MATERIALS

Used polypropylene (PP), polypropylene co polymer (CP) and acrylo butadiene styrene (ABS) are collected from houses and rag pickers

III. FABRICATION OF TILES

Various formulations of tiles have been prepared by modulating the weight PP copolymer (CP) and acrylo butadiene styrene (ABS) along with polypropylene (PP) These materials are homogenized by using ball mill and then injection molded to design tiles. In addition, tile form PP without any filler has also been fabricated for comparative study.

IV. CHARECTERIZATION

Tensile strength test has been performed on Universal Test Machine (UTM) by ASTM D638 method to measure the force required to break a plastic sample specimen. Izod Impact (a single point test) has been carried out by ASTM D256 standard method to measure a materials resistance against impact from a swinging pendulum. Durometer Hardness test has been done on Hardness Tester by ASTM D2240 method to

determine the relative hardness of the specimens. The flammability test has been done on Flammability Apparatus by ASTM D635 method to determine the relative rate of burning of plastics specimens.

V. RESULT AND DISCUSSION

Tensile strength

It covered the determination of the tensile properties of tiles in the form of standard dumbbell-shaped test specimens when tested under defined conditions of pre-treatment, temperature, humidity and testing machine speed. Specimens were placed in the grips of the universal tester at a specified grip separation and pulled until failure. The test produced a stress-strain diagram, which was used to determine the tensile modulus.

It has been observed from fig. 1 that PP tile sample shows tensile strength of 24.7 N/mm2 which further increases to 27.4 N/mm2 for PPCP (PP+CP) tile sample but when ABS has been added to this sample, a drastic increase in tensile strength has been observed with a value of 36.2 N/mm2 for PPCABS (PP+CP+ABS) tile sample.

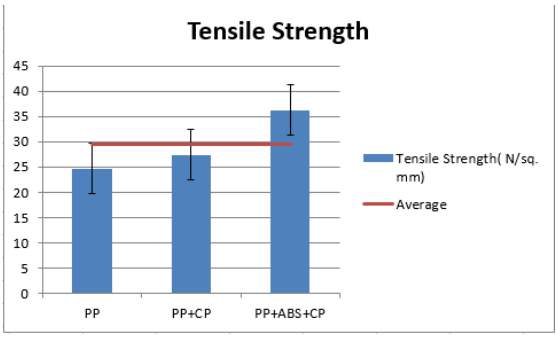

Fig 1: Graphical comparison of Tensile Strength test for various PP tiles.

It has been observed from fig. 2 that PP tiles shows 12% of elongation at break which further increases to 20% for PPCP(PP+CP) tiles while PPCABS(PP+CP+ABS) tile sample shows 28 % elongation at break.

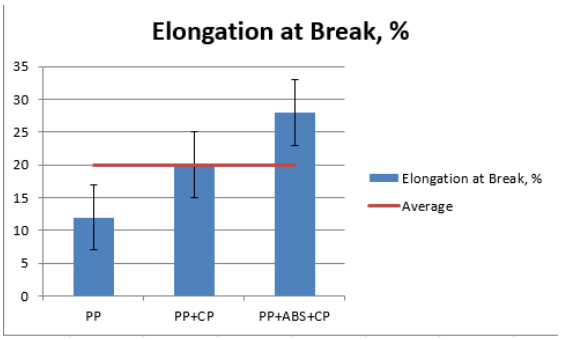

Fig 2:Graphical comparison of Elongation at break test for various PP tiles

Izod Impact strength

Izod specimen is notched to prevent deformation of the specimen upon impact. The specimen was clamped into the pendulum impact test fixture with the notched side facing the shrinking edge of the pendulum. The pendulum was released and allowed to strike through the specimen. The standard specimen for the test has been taken as 64 x 12.7 x 8 mm. The depth under the notch of the specimen was 10.2 mm (0.4 inches). For this test, 5 specimens from each sample have been tested.

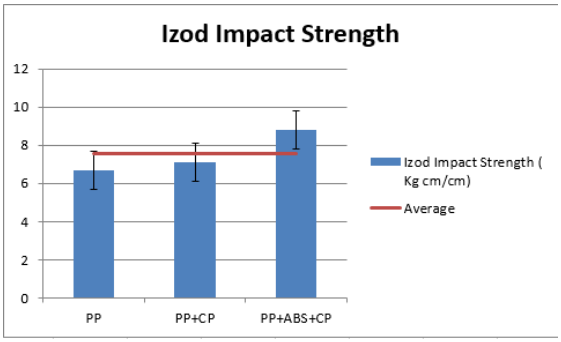

Fig 3: Graphical comparison of Impact Strength test for various PP tiles.

It has been observed from fig. 3 that PP tiles show 6.7 Kg cm/cm impact strength which further increases to 7.1 Kg cm/cm for PPCP (PP+CP) tiles. With the incorporation of ABS impact strength further improved to 8.8 Kg cm/cm, which is an excellent improvement as comparative to PP tiles.

Hardness (Shore D)

This test measured the penetration of a specified indentor into the material under specified conditions of force and time. The test specimen was 8mm thick. The hardness numbers were derived from a Shore D hardness scales. The test result was the average of results obtained from 5 specimens of each sample.

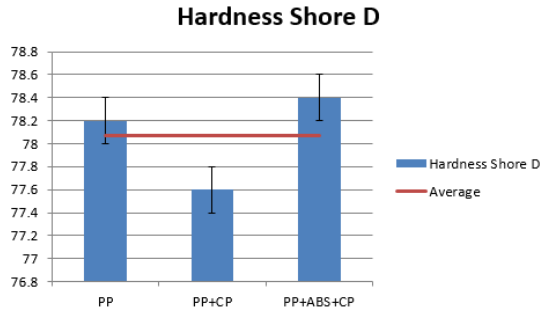

Fig 4: Graphical comparison of Hardness Shore D test for various PP tiles.

It has been observed from fig. 4 that PP tiles shows an average value of 78.2 hardness shore D which further decreases to 77.6 hardness shore D for PPCP (PP+CP) sample, while PPCABS(PP+CP+ABS) tiles shows a mean value of 78.4 hardness shore D which is much closer value to that of PP tiles.

Flammability test

Specimen size for ASTM D635 was 125 mm long x 13 mm wide x 8mm thick. The test has been done at 23°C and 50% R.H. for 48 hours. The test result was the average of 5 specimens of each sample.

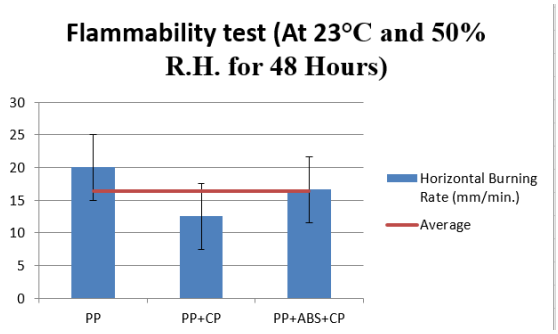

Fig 5: Graphical comparison of Flammability test for various PP tiles.

It has been observed from fig. 5 that PP tiles shows an average value of 20 mm/min horizontal burning rate which further decreases to 12.5 mm/min horizontal burning rate for PPCP (PP+CP) sample due to presence of ethylene in CP, while PPCABS(PP+CP+ABS) tiles shows a mean value of 16.6 mm/min Horizontal burning rate.
All the test results show that PPCABS sample has the highest hardness, tensile strength, Impact strength and moderate flammability amongst the three samples due to the presence of ABS and CP.

VI. CONCLUSIONS

The experimental results presented in the work demonstrate the feasibility of utilisation of PP in the form of light weight PP/CP/ABS composites as a high performance building material for tiles. The presence of CP offers less flammability due to the presence of Ethylene and good tensile and impact strength. The presence of ABS offers good mechanical properties to withstand heavy load and high pressure conditions, thus improving the quality of the plastic tile. These tiles can be used as light weight building materials for commercial use.

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REFERENCES

[1] A. K. Temitope, O. O. Abayomi, A. O. Ruth, A. P. Adeola , “A Pilot Recycling of Plastic Pure Water Sachets/Bottles into Composite Floor Tiles: A Case Study from Selected Dumping Site in Ogbomoso”, J Material Science and engineering, vol 4, pp 1-5, 2015.
[2] B. K. Kashiyani, J.K. Pitroda, B. K. Shah,” A Study of Utilization Aspect of Polypropylene Fibre for Making Value Added Concrete” , international journal of scientific research, vol 2, pp 103-106, 2013.
[3] Modern Plastics Handbook, Charles A. Harper Editor in Chief, Technology Seminars, Inc., Lutherville, Maryland- McGraw-Hill.
[4] K. Murahari , R.M. Rao p, Effects of Polypropylene fibres on the strength properties Of fly ash based concrete, International Journal of Engineering Science Invention, Vol 2,pp 13-19, 20