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PROJECT CLOSING REPORT

DEVELOPMENT OF NON-WOVEN COIR GEO-TEXTILES COMPOSITES USING INNOVATIVE MANUFACTURING TECHNIQUES

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DEVELOPMENT OF NON WOVEN COIR GEO-TEXTILES COMPOSITES USING INNOVATIVE MANUFACTURING TECHNIQUES

1.	Project Title	Development of Non-woven Coir Geo-textile Composites Using Innovative Manufacturing Techniques
2.	Broad Subject	Geo-technical Engineering
3.	Sub Area	Civil Engineering
4.	Duration of the project	12 months
5.	Total cost	Rs. 9, 76,800.00 (Rupees Nine Lakhs Seventy Six Thousand Eight Hundred only)
6.	Project Category	Applied Research
7.	Principal Investigator	Dr. R. Gopalan, Executive Director
8.	Name of the institution	SOCIETY FOR DEVELOPMENT OF COMPOSITES Composites Technology Park, TBI Block, #205, Banda Mutt, Kengeri Satellite Township, Bangalore-560 060 %: 65997605 / 65581005 / 28482768 Fax:080-2848 2771 (A non-for profit, registered society under the Karnataka Societies Registration Act, Bangalore) <u>in technical collaboration with</u> RV-TIFAC COMPOSITES DESIGN CENTRE Composites Technology Park, #205, Banda Mutt, Kengeri Satellite Township, Bangalore-560 060

		Ph: 65997605 / 65581005 Fax:080-2848 2771 (An autonomous body set up by TIFAC / Department of Science & Technology, Govt. of India, National Aerospace Laboratories and the RSS Trust, Bangalore)Indian Institute of Science
9	Date of Start	February 2008
10	Date of Closing	November 2009

1. PROJECT SUMMARY

A geo-textile is typically defined as natural-fibre based textile material used for increasing soil stability, providing erosion control or aiding drainage. More simply put, if any material is made out of fabrics and buried in the ground, it is probably a geo-textile.

Geo-textiles have been in use for thousands of years dating back to the Egyptian Pharaohs. These early geo-textile applications were basically natural fibers or vegetation mixed directly with the soil. Modern geo-textiles are usually made from a synthetic polymer such as polypropylene, polyester, polyethylene and polyamides. Geo-textiles can be woven, knitted or non-woven. Varying the polymers and the manufacturing processes resulted in the development of an array of geo-textiles suitable for a variety of civil construction applications.

Non-woven geo-textiles resemble felt and provide planar water flow. They are commonly known as filter fabrics (although woven monofilament filtration fabrics also exist). Typical applications for non-woven geo-textiles include aggregate drains, asphalt pavement overlays, and erosion control. Non-woven geo-textiles are multi-purpose fabrics that are felt-like in appearance.

There are numerous practical applications for non-woven geo-textiles. Non-woven drainage fabrics are an economical alternative to graded aggregate and sand filters and can eliminate many of the problems associated with using, purchasing and transporting aggregates. Development of innovative methodologies for rural road construction is an ambitious and important programme in achieving cost effective rural road network development. It has been a well-established fact that the rural road network in India needs to be improved and organized. In many areas in rural India, construction of roads in soft soils needs to be undertaken. While different methods of ground improvement are available for roads in urban areas, which justify the costs in terms of returns, these methods are expensive for rural roads. Hence, it is necessary to develop cost effective coir geo-textile composites for rural road construction.

The project proposal on development of “Non-Woven Coir Geo-textiles Composites” (CGC), using innovative manufacturing techniques, envisages the use of hybrid fibres, polymers and innovative design methodologies for development of coir geo-textile composites. These reports presents development of 3 types of coir fiber non-woven geo-

textile fabrics: Light weight, Medium weight and Heavy weight and also coir fiber geo-textile composites combined with natural rubber to the 3 types of coir non-woven geo-textile fabrics. Detailed results are presented in 18 Tables in this report.

This report presents development of 3 types of Coir Geo Textiles Fabrics Light weight, medium weight and heavy weight and Coir Geo Textiles Composites of these three types

2. OBJECTIVES

Development of non-woven coir geo-textile composites for lightweight, medium-weight and heavyweight fabrics for technical textile applications, using innovative manufacturing techniques and optimizing product process flow

2.1 LIGHT WEIGHT NON-WOVEN COIR GEO-TEXTILES COMPOSITES

Most lightweight non-woven coir geo-textile composites are used as filter fabrics in subsurface drainage applications. High flow rates and small openings are what make these non-woven coir geo-textile composites ideal for use as filter fabrics Wrapping a non-woven coir geo-textile composites filter around the drainage system allows water into the drain, while preventing soils from clogging the system.

In addition to drainage, lightweight non-woven coir geo-textile composites filter fabrics are often used as landscape fabrics, weed barriers or for lightweight separation under pavers. Another use of lightweight non-woven coir geo-textile composites is for asphalt overlay. These particular non-woven coir geo-textile composites are designed to hold tack coat and withstand extreme temperatures. Placing non-woven coir geo-textile composites between the old asphalt and the new overlay reduces reflective cracking and extends the life of the asphalt. A moisture barrier that protects the overlay fabric from water intrusion is created when the non-woven coir geo-textile composites absorb the tack coat.

2.2 MEDIUM WEIGHT NON-WOVEN COIR GEO-TEXTILES COMPOSITES

Medium-weight non-woven coir geo-textile composites are most commonly used for erosion control. A non-woven coir geo-textile

composite allows water to pass through it while keeping existing soils in place. In addition, non-woven coir geo-textile composites can be used in separation/drainage applications. The non-woven can also used to protect stream crossings, feeding troughs, watering ramps, feedlots and loafing areas. Non-woven coir geo-textile composites used as a cow carpet will provide better footing and create a healthier environment for the animals.

2.3 HEAVY WEIGHT NON-WOVEN COIR GEO-TEXTILES COMPOSITES

Heavyweight non-woven coir geo-textile composite fabrics can be used as a geo-membrane cushion. Placing a non-woven geo-textile above or below the geo-membrane helps protect it from punctures. Heavyweight non-woven fabrics are also used for railroad stabilization. When placed under tracks, non-woven geo-textiles prevent intermixing of the ballast with the soil.

3. PROGRESS OF WORK DONE

As envisaged in the project, coir geo-textile composites of the following 3 categories were developed using non-woven felt making machine:

1. Lightweight Non-Woven Coir-Composite Geo-Textile fabrics.
2. Medium weight Non-woven Coir-Composite Geo-Textile fabrics.
3. Heavy weight Non-woven Coir-Composite Geo-Textile fabrics.

3.1 Defining the light weight, medium weight and heavy weight Coir - Composite Geo-Textile Fabrics:

Based on the information collected for woven coir composite geo-textiles and also jute-composite geo-textiles, it was decided to develop the following:

1. Light-weight non-woven coir-composite geo-textile fabric with density of 450-500 grams/m2.
2. Medium-weight non-woven coir composite geo-textile fabric with density of 650-700 grams/m2.

3. Heavy-weight non-woven coir composite geo-textile fabric with density of 900-950 grams/m2.

4. MANUFACTURE OF NON-WOVEN COIR GEO-TEXTILES FABRICS

The above 3 categories of coir-composite geo-textiles fabrics were developed, using the non-woven felt machine. In order to achieve the required density lightweight (450-500 grams/m2), medium weight (650-700 grams/m2) and heavy weight (900-950 grams/m2), non-woven geo-textile fabrics, necessary modifications on the needle felt manufacturing machine were carried out. Several trails were carried out to obtain the geo-textiles with desired density. After achieving the consistent quality in the densities of the coir geo-textiles as above, a roll of 100 meters of coir geo-textile fabrics were manufactured in each of the above categories. The photographs of light weight, medium weight and heavy weight non-woven coir geo-textiles fabrics rolls are shown in figs 1, 2 and 3 respectively.

4.1 Determination of density of coir geo-textile fabrics

9 samples of 1 meter x 1 meter coir geo-textiles fabrics in each of the above 3 categories were taken from the 100 meters roll. Weight measurements were taken for each of the samples and density was calculated. Tables 1 to 3 show the details of weight and density calculations for the lightweight, medium weight and heavy weight coir fibre non-woven geo-textile fabrics respectively.

5. DEVELOPMENT OF COIR FIBRE NON-WOVEN GEO-TEXTILE COMPOSITES: SELECTION OF POLYMER

In order to improve / enhance the mechanical properties (pull strength, stretch strength, and tear strength etc.,) of the 3 categories of non-woven coir geo-textile fabrics as described above, the geo-textile fabrics were reinforced with 3 types of polymers as given below:

1. **Natural Rubber**

2. Polyvinyl Alcohol (PVA)

General Properties of PVA

Polyvinyl alcohol has excellent film forming, emulsifying, and adhesive properties. It is also resistant to oil, grease and solvent. It is odorless and nontoxic. It has high tensile strength and flexibility, as well as high oxygen and aroma barrier properties. However these properties are dependent on humidity, in other words, with higher humidity more water is absorbed. The water, which acts as a plasticizer, will then reduce its tensile strength, but increase its elongation and tear strength. PVA is fully degradable and is a quick dissolver. PVA has a melting point of 230°C and 180-190°C for the fully hydrolysed and partially hydrolysed and partially hydrolysed grades, respectively. It decomposes rapidly above 200°C as it can undergo pyrolysis at high temperatures.

PVA is an atactic material but exhibits crystallinity as the hydroxyl groups are small enough to fit into the lattice without disrupting it.

General Uses

Preparation of polyvinyl butyral is the largest use for polyvinyl alcohol in the U.S. and Western Europe. Its use as a polymerization aid is the largest market in China. In Japan the major use is vinylon fibre production.

Some other uses of polyvinyl alcohol include:

1. Adhesive and thickener material in latex paints, paper coatings, release liner, hairsprays, shampoos and glues.
2. Textile sizing agent.
3. Carbon dioxide barrier in polyethylene terephthalate (PET) bottles.
4. Carotid phantoms for use as synthetic vessels in Doppler flow testing
5. Movie Practical effect and children's play putty or slime when combined with borax
6. Feminine hygiene and adult incontinence products as a biodegradable plastic backing sheet.
7. As a mold release because materials such as epoxy do not stick to it
8. As a water-soluble film useful for packaging
9. As fiber reinforcement in concrete
10. As a surfactant for the formation of polymer encapsulated nanobeads
11. Used with polyvinyl acetate to make Elmer's glue

12. Used in eye drops and hard contact lens solution as a lubricant
13. Used in protective chemical-resistant gloves
14. Used as a fixative for specimen collection, especially stool samples
15. When doped with iodine, PVA can be used to polarize light
16. As an embolization agent in medical procedures

3. Acrylic Binder

5.1 Application of natural rubber on non-woven geo-textile fabrics and composites

Natural rubber was sprayed on the lightweight, medium weight and heavy weight coir fibre geo-textile fabrics. 6 samples of 1 meter X 1 meter were cut from the 100-meter roll of the 3 categories of the geo-textile fabrics. The initial weights of the samples were taken before spraying the natural rubber. The geo-textile fabrics samples were then sprayed with natural rubber using a special spray system and cured at 120 degree centigrade temperature in an oven. The weight of the fabrics after spraying the natural rubber were measured. The weight of natural rubber sprayed and percentage of resin and fibre weight were then calculated. Tables 4 – 6 present the details of calculations for the lightweight, medium weight and heavy weight coir fibre non-woven geo-textiles fabrics respectively.

The procedure was repeated by taking six sets of coir geo-textile fabrics in each category and the natural rubber was sprayed on the samples. The N.R. sprayed samples were cured at 120 degree C past through hot roller to get uniform and smooth surface of the geo-textile composite. The weight of the geo-textile composites were measured and the densities, percentage of N.R. and the percentage of fibre were determined and presented in Tables 7-9 for light weight, medium weight and heavy weight coir geo-textile composites respectively. The figs 5, 6 and 7 show the lightweight, medium weight and heavy weight non-woven coir geo-textile composite respectively.

Natural rubber was taken and mixed with water the ratio of resin to water is 1:1, 1:3 and 1:4. The purpose of mixing with water for reducing the resin Content. The mixed Rubber (ratio 1:1) was sprayed on the Light Weight, Medium Weight, and Heavy weight coir fiber geo textile fabrics samples of 1 M $\times$1M were cut from the 100 meter roll of the 3 categories of the geo textile fabrics. The initial

weight of the samples was taken before spraying the natural rubber. The geo textile fabrics samples were then sprayed with natural rubber using a special spray system and cured at 120 degree centigrade temperature in an oven. The weight of the fabrics after spraying the natural rubber (1:1) were measured the weight of natural rubber sprayed and presented of resin and fiber weight was then calculated. Table 10-12 present the details of calculation for the Lightweight, Medium Weight, and Heavy Weight coir Geo Textile Composites respectively.

The procedure was repeated by taking samples of coir geo textiles fabrics in each category and Natural rubber with water (ratio1:3) was sprayed on the samples. The weight of the fabrics after spraying the Natural Rubber with water were measured the weight of natural rubber sprayed and presented of resin and fiber weight were determined and presented in Table 13 -15 for Light Weight, medium weight, and heavy weight coir geo Textile Composite respectively. The weight of the fabrics after Spraying the natural Rubber with Water Ratio 1:4 were measured the weight of natural rubber sprayed and presented of resin and fiber weight were determined and presented in Table16 -18 for Light weight, medium weight, and Heavy weight Coir geo textile composite respectively.

5.2 Impregnation of Polyvinyl Alcohol on non-woven geo-textile fabrics and composites

The PVA is available in liquid form. PVA solution was prepared by diluting with water. Different PVA content solution was prepared: PVA : Water = 1:1, 1:2, 1:3, 1:4, 1:6 and 1:8 was prepared to get varied polymer content. The PVA solution was applied by brush to the light, medium and heavy weight non-woven coir geo-textiles fabrics. The resin impregnated coir geo-textile fabric was cured by sun drying and to remove the excess moisture to obtained PVA – non-woven coir geo-textile composites. The non-woven PVA coir composite textile was subjected to visual inspection and mechanical test to determine physical and mechanical properties. The visual inspection revealed that the PVA – non-woven coir geo-textile composites has good stiffness and strength properties. The density and resin content calculations were made for light, medium and heavy weight PVA – non-woven coir geo-textile composites and the results are presented in tables 20 – 25 respectively. The photographs of the PVA – non-woven coir geo-textile composites are shown in figures 8 – 10 respectively.

5.3 Impregnation of Acrylic Binders on non-woven geo-textile fabrics and composites

Acrylic binders are environment friendly water based binder suitable for natural fibers. 3 grades of acrylic resin binders namely; HA 16, HA 20 and HA 24 were obtained from a commercial source. The acrylic binder contents polycarboxylic acid with polyhydric alcohol as cross linking agent.

Acrylic binder solution was prepared by mixing with water at a ratio of Acrylic Binder : Water = 1:1, 1:2, 1:3, 1:4, 1:6 and 1:8. The acrylic binder solution was impregnated with light, medium and heavy weight non-woven coir geo-textile fabrics by means of brush. The impregnated coir geo-textile fabric was sun dried and cured to get acrylic – non-woven coir geo-textile composite. Physical and mechanical test were carried out to determine the density, resin content and mechanical properties. The density and resin content results for light, medium and heavy weight acrylic – non-woven coir geo-textile are presented in table 26 – 43 respectively. The photographs of light, medium and heavy weight – acrylic binder HA 16, HA 20 and HA 24 composites are shown in figures 11-13 respectively.

6. RESULTS AND DISCUSSIONS

The light weight, medium weight and heavy weight coir fibre non-woven geo-textiles fabrics were successfully developed using innovative non-woven needle felt process. The average densities of the light weight, medium weight and heavy weight coir geo-textile were determined and found to be 490 grams/m2, 660 grams/m2 and 930 grams/m2 respectively.

In order to increase the mechanical properties and enhance the water resistant characteristics of the light, medium weight and heavy weight coir geo-textile fabrics developed as above were impregnated with natural adhesive namely natural rubber. The natural rubber was impregnated to the non-woven coir geo-textile fabrics using spray techniques and cured in a hot air woven and converted in to coir geo-textile composites. The natural rubber content in the coir geo-textile composites was determined and found to be 33.63%, 26.5% and 25.2% respectively in the lightweight, medium weight and heavy weight coir geo-textile composites. The average densities and

percentage of resin Content of the light weight, Medium weight and Heavy weight after impregnated with natural rubber using spray method was determined and found to be 775.6 g/m², 940.54 g/m², 1311 g/m² respectively.

In order to further improve /enhance the resin content and mechanical properties of light weight, medium weight and heavy weight, coir geo-textile fabrics developed as above were impregnated with diluted the natural rubber with water.

The natural rubber was mixed with water in a ratio of resin: to water = 1:1, 1:3 and 1:4 and impregnated to the non woven coir geo textile using spray techniques and converted into coir geo textile composite. The resin content for the light weight, medium weight and heavy weight coir geo-textile composite impregnated with natural resin 1:1, 1:3 and 1:4 were determined and presented in Table 19.

The PVA – Non-Woven Coir Geo Textile Composites with varying fiber resin ratio namely 1:1, 1:2, 1:3, 1:4, 1:6 and 1:8 were prepared for detail testing and evaluation. These non woven coir composites are found to be of higher tensile properties and tear strength. The density calculations for these PVA Non woven Coir Geo Textile Composites was determined and presented in tables 20 – 25.

Similarly acrylic binder resin grades HA 16, HA 20 and HA 24 were procured and impregnated with non woven coir geo textiles with fiber: resin ratio to prepare acrylic Non-woven Coir Geo Textile Composites. These Coir Geo Textile Composites was found to be of higher tensile properties and tear strength. The density calculations for this acrylic resin - Non woven Coir Geo Textile Composites was determined and presented in tables 26 – 43.

The Mechanical properties of natural rubber, PVA and acrylic resin impregnated, light, medium and heavy weight non woven coir geo textile composite are determined and reported separately.

7. CONCLUSION

Development of Non- woven Coir Geo Textile Fabric and composites using innovative manufacturing technique using needle punch

method and then reinforcing with natural rubber was successfully carried out. The average density of the lightweight, medium weight and heavy weight coir geo textile fabrics were 490 g/m², 660g/m², and 930g/m². The Natural Rubber was impregnated with out water with the coir geo textile fabrics for improving the mechanical properties. Two techniques were used for impregnation (a) Spray technique (b) Spray and passed through hot Roller. The average densities and percentage of resin Content of the light weight, Medium weight and Heavy weight after impregnated with natural rubber (with out water) using spray method was found to be 775.6 g/m², 940.54 g/m², 1311 g/m² and Resin Content is 36.33%, 28.39 %and 27.73 % respectively. Further the Natural rubber Sprayed and passed through hot roller the density and resin content were 690.36g/m², 957.59 g/m², 1160.59 g/m² and Resin Content is 28.53%, 26.37 %and 23.95 % respectively, in the light weight, medium weight, and heavy weight coir geo textile composites.

The natural rubber was mixed with water and it was impregnated with Coir geo textile fabrics for reducing resin content and improving the mechanical properties by spray techniques. The weight and density of the Light Weight, Medium Weight and Heavy weight Coir geo textiles fabrics (Composites) impregnated with natural rubber percentage of natural rubber content was determined and presented in Table 19. Light Weight Medium Weight Heavy weight Coir geo textile Composite respectively.

The PVA – Non-Woven Coir Geo Textile Composites with varying fiber resin ratio namely 1:1, 1:2, 1:3, 1:4, 1:6 and 1:8 were prepared for detail testing and evaluation. These non woven coir composites are found to be of higher tensile properties and tear strength. The density calculations for these PVA Non woven Coir Geo Textile Composites was determined and presented in tables 20 – 25.

Similarly acrylic binder resin grades HA 16, HA 20 and HA 24 were procured and impregnated with non woven coir geo textiles with fiber: resin ratio to prepare acrylic Non- woven Coir Geo Textile Composites. These Coir Geo Textile Composites was found to be of higher tensile properties and tear strength. The density calculations for this acrylic resin - Non woven Coir Geo Textile Composites was determined and presented in tables 26 – 43.

The Mechanical properties of natural rubber, PVA and acrylic resin impregnated, light, medium and heavy weight non woven coir geo textile composite are determined and reported separately.

The samples of Coir geo-textile fabrics and composites of light weight, medium weight and heavy weight have been tested to determine the physical and mechanical properties as per IS and international standard and specification and results are presented in a separate report.

Fig: 1 Light Weight Non-Woven Coir Geo-Textile Fabric (500 g/m^2)

Fig: 2 Medium Weight Non-Woven Coir Geo-Textile Fabric (700 g/m²)

Fig: 3 Heavy Weight Non-Woven Coir Geo-Textile Fabric (950 g/m²)

Fig: 4 Light, Medium and Heavy Weight Non-Woven Coir Geo-Textile Fabric

Fig: 5 Light Weight Non-Woven Coir Geo-Textiles Composite (500 g/m²)

Fig: 6 Medium Weight Non-Woven Coir Geo-Textiles Composite (700 g/m²)

Fig: 7 Heavy Weight Non-Woven Coir Geo-Textiles Composite (950 g/m²)

Fig: 8 Light, Medium and Heavy weight Non-Woven Coir Geo-Textiles Composite with PVA

Fig: 9 Non-Woven Coir Geo-Textiles Composites Acrylic Binder

Fig: 10 Light, Medium and Heavy weight Non-Woven Coir Geo-Textiles Composite with HA 16 1:1 to 1:8

Fig: 11 Light, Medium and Heavy weight Non-Woven Coir Geo-Textiles Composite with HA 20 1:1 to 1:8

Fig: 12 Light, Medium and Heavy weight Non-Woven Coir Geo-Textiles Composite with HA 24 1:1 to 1:8

Table 1. Light Weight Non-Woven Coir Geo-Textile Fabric (500 Grams/m2)

Sl. No.	Length	Width	Weight Grams	Density Grams/m2	Density Grams/sft
1	**1000**	**1010**	**500**	**495.05**	**46.05**
2	**1000**	**1010**	**500**	**495.05**	**46.05**
3	**1000**	**1010**	**480**	**475.25**	**44.2**
4	**1000**	**1010**	**470**	**465.35**	**43.28**
5	**1000**	**1010**	**490**	**485.14**	**45.13**
6	**1000**	**1010**	**480**	**475.25**	**43.77**
7	**1000**	**1010**	**520**	**514.85**	**47.41**
8	**1000**	**1010**	**520**	**514.85**	**47.41**
9	**1000**	**1010**	**500**	**495.05**	**46.05**
Average:			495.55	490.64	45.48

Table 2. Medium Weight Non-Woven Coir Geo-Textile Fabric (700 Grams/m2)

Sl. No.	Length	Width	Weight Grams	Density Grams/m2	Density Grams/sft
1	**1005**	**1010**	**640**	**630.5**	**58.65**
2	**1000**	**1010**	**630**	**623.76**	**58.02**
3	**1000**	**1010**	**660**	**653.46**	**60.78**
4	**1000**	**1070**	**760**	**710.28**	**66.07**
5	**1000**	**1040**	**700**	**673.08**	**62.61**
6	**1000**	**1040**	**700**	**673.08**	**62.61**
7	**1000**	**1070**	**700**	**654.2**	**60.85**
8	**1000**	**1040**	**680**	**653.85**	**60.52**
Average:			683.75	658.61	61.22

Table 3. Heavy Weight Non-Woven Coir Geo-Textile Fabric (950 Grams/m2)

Sl. No.	Length	Width	Weight Grams	Density Grams/m2	Density Grams/sft
1	**1000**	**1010**	**950**	**940.59**	**87.5**
2	**1000**	**1010**	**920**	**910.89**	**84.73**
3	**1000**	**1010**	**980**	**970.30**	**90.26**
4	**1000**	**1020**	**975**	**955.88**	**88.92**
5	**1010**	**1020**	**960**	**941.18**	**86.68**
6	**1010**	**1020**	**950**	**931.37**	**83.26**
7	**1010**	**1010**	**950**	**940.59**	**86.63**
8	**1010**	**1010**	**950**	**940.59**	**86.63**
9	**1008**	**1015**	**900**	**886.99**	**82.07**
Average:			948.33	935.37	86.29

Table 4. Light Weight Non-Woven Coir Geo-Textile Composite (500 Grams/m^2) after spraying with Natural Rubber

Sl. No.	Sample Size mm	Initial weight coir felt (grams)	Weight after spraying the N.R. weight grams	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1000X1010**	**470**	**750**	**742.6**	**280**	**37.33**	**62.67**
2	**1000X1010**	**440**	**750**	**742.6**	**260**	**34.66**	**65.64**
3	**1000X1010**	**480**	**850**	**841.6**	**370**	**43.52**	**56.48**
4	**1000X1010**	**520**	**750**	**742.6**	**230**	**30.66**	**69.34**
5	**1000X1010**	**520**	**750**	**742.6**	**230**	**30.66**	**69.34**
6	**1000X1010**	**500**	**850**	**841.6**	**350**	**41.17**	**58.83**
Avg:	1000X1010	496.66	783.33	775.6	286.67	36.33	63.70

Table 5. Medium Weight Non-Woven Coir Geo-Textile Composite (700 Grams/m²) after spraying with Natural Rubber

Sl. No.	Sample Size mm	Initial weight coir felt (grams)	Weight after spraying the N.R. weight grams	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1000X1070**	**760**	**1050**	**981.3**	**290**	**27.61**	**72.39**
2	**1000X1040**	**700**	**950**	**913.46**	**250**	**26.31**	**73.69**
3	**1000X1040**	**700**	**950**	**913.46**	**350**	**26.31**	**73.69**
4	**1000X1070**	**700**	**1050**	**981.3**	**350**	**33.33**	**66.67**
5	**1000X1040**	**680**	**950**	**913.46**	**270**	**28.42**	**71.58**
Avg:	1001X1052	708	990	940.54	282	28.39	71.60

Table 6. Heavy Weight Non-Woven Coir Geo-Textile Composite (900 Grams/m²) after spraying with Natural Rubber

Sl. No.	Sample Size mm	Initial weight coir felt (grams)	Weight after spraying the N.R. weight grams	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1000X1020**	**975**	**1350**	**1323.52**	**375**	**27.77**	**72.23**
2	**1010X1020**	**960**	**1350**	**1310.45**	**335**	**28.51**	**71.11**
3	**1010X1020**	**950**	**1300**	**1261.89**	**350**	**26.92**	**73.08**
4	**1010X1010**	**950**	**1300**	**1274.38**	**350**	**26.92**	**73.08**
5	**1010X1010**	**950**	**1200**	**1176.35**	**250**	**20.83**	**79.16**
6	**1010X1010**	**900**	**1550**	**1519.45**	**550**	**35.48**	**64.52**
Avg:	1008x1015	947.5	1341.66	1311.00	376.66	27.73	71.11

Table 7. Light Weight Non-Woven Coir Geo-Textile Composite (500 Grams/m²) sprayed with natural rubber and passed through hot roller

Sl No	Sample Size mm	Initial weight Coir felt (grams)	Weight after spraying the N.R. Wet	Density of Coir felt after spraying N.R grams/m2	Weight of the N.R.	% of Natural Rubber	% of Coir Fibre
1	**1005X765**	**377.21**	**570**	**741.39**	**192.74**	**33.82**	**66.17**
2	**1005X995**	**463.5**	**660**	**698.63**	**196.5**	**29.77**	**70.22**
3	**1010X965**	**483.28**	**670**	**680.2**	**186.72**	**27.86**	**72.13**
4	**1010X985**	**485.64**	**690**	**697.02**	**206.72**	**29.95**	**70.38**
5	**1005X990**	**488.16**	**690**	**693.5**	**201.84**	**29.25**	**70.74**
6	**1005X1040**	**512.81**	**660**	**631.45**	**147.19**	**22.3**	**77.69**
Avg:		468.88	659.66	690.36	188.22	28.53	71.01

Table 8. Medium Weight Non-Woven Coir Geo-Textile Composite (700 Grams/m²) sprayed with natural rubber and passed through hot roller

Sl No	Sample Size mm	Initial weight Coir felt (grams)	Weight after spraying the N.R. Wet	Density of Coir felt after spraying N.R grams/m2	Weight of the N.R.	% of Natural Rubber	% of Coir Fibre
1	**1015X835**	**558.18**	**970**	**1144.50**	**411.81**	**42.45**	**57.54**
2	**1035X1000**	**681.66**	**940**	**908.21**	**258.34**	**27.48**	**72.51**
3	**1015X1020**	**681.85**	**950**	**917.6**	**268.15**	**28.22**	**71.77**
4	**1040X995**	**681.52**	**890**	**860.06**	**208.48**	**23.42**	**76.57**
Avg:		650.8	937.5	957.59	286.69	26.37	69.41

Table 9. Heavy Weight Non-Woven Coir Geo-Textile Composite (900 Grams/m2) sprayed with natural rubber and passed through hot roller

Sl No	Sample Size mm	Initial weight Coir felt (grams)	Weight after spraying the N.R. Wet	Density of Coir felt after spraying N.R grams/m 2	Weight of the N.R.	% of Natural Rubber	% of Coir Fibre
1	**1005X1035**	**968.3**	**1000**	**961.37**	**317**	**31.7**	**68.2**
2	**1015X985**	**930.5**	**1240**	**1240.27**	**309.5**	**24.45**	**75.04**
3	**1020X975**	**925.59**	**1190**	**1196.58**	**264.41**	**22.21**	**77.78**
4	**1020X985**	**935.08**	**1250**	**1244.15**	**314.92**	**25.19**	**74.8**
Avg:		939.74	1170	1160.59	230.26	23.95	76.05

Table 10. Light Weight Non-Woven Coir Geo-Textile Composite (500 Grams/m^2) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:1

Sl. No.	Sample Size (mm)	Initial weight coir felt (grams)	Weight after spraying the N.R. weight (grams)	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1500X1000**	**735.96**	**800**	**533.33**	**64.04**	**8.0**	**91.90**
2	**1000X1000**	**460.00**	**500**	**500.00**	**40.00**	**8.0**	**92.00**
Avg.	1250X1000	597.98	650	516.66	52.02	8.0	91.95

Table 11. Medium Weight Non-Woven Coir Geo-Textile Composite (700 Grams/m²) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:1

Sl. No.	Sample Size (mm)	Initial weight coir felt (grams)	Weight after spraying the N.R. weight (grams)	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1000X1000**	**658.61**	**780**	**780.0**	**121.39**	**15.56**	**84.43**
2	**1010X1000**	**665.19**	**760**	**752.47**	**94.81**	**12.47**	**87.52**
Avg.	1005X1000	661.9	770	766.23	108.1	14.01	85.97

Table 12. Heavy Weight Non-Woven Coir Geo-Textile Composite (950 Grams/m²) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:1

Sl. No.	Sample Size (mm)	Initial weight coir felt (grams)	Weight after spraying the N.R. weight (grams)	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1010X860**	**808.41**	**920**	**1059.17**	**111.59**	**12.12**	**87.87**

Table 13. Light Weight Non-Woven Coir Geo-Textile Composite (500 Grams/m²) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:3

Sl. No.	Sample Size (mm)	Initial weight coir felt (grams)	Weight after spraying the N.R. weight (grams)	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1000X1000**	**470**	**500**	**500**	**30**	**6.0**	**94.0**

Table 14. Medium Weight Non-Woven Coir Geo-Textile Composite (700 Grams/m²) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:3

Sl. No.	Sample Size (mm)	Initial weight coir felt (grams)	Weight after spraying the N.R. weight (grams)	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1000X1000**	**660.0**	**720**	**720**	**60**	**8.33**	**91.66**

Table 15. Heavy Weight Non-Woven Coir Geo-Textile Composite (950 Grams/m²) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:3

Sl. No.	Sample Size (mm)	Initial weight coir felt (grams)	Weight after spraying the N.R. weight (grams)	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1000X1000**	**930**	**1000**	**1000**	**70**	**7.00**	**93.00**
2	**1000X1000**	**910**	**980**	**980**	**70**	**7.14**	**92.85**
Avg.	1000X1000	920	990	990	70	7.07	92.92

Table 16. Light Weight Non-Woven Coir Geo-Textile Composite (500 Grams/m²) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:4

Sl. No.	Sample Size (mm)	Initial weight coir felt	Weight after spraying	Density of Coir felt after	Weight of Rubber	% of Natural Rubber	% of Coir Fiber

		(grams)	the N.R. weight (grams)	spraying N.R grams/m2	(grams)		
1	**1000X1000**	**470**	**480**	**480**	**10**	**2.12**	**92.0**

Table 17. Medium Weight Non-Woven Coir Geo-Textile Composite (700 Grams/m²) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:4

Sl. No.	Sample Size (mm)	Initial weight coir felt (grams)	Weight after spraying the N.R. weight (grams)	Density of Coir felt after spraying N.R grams/m2	Weight of Rubber (grams)	% of Natural Rubber	% of Coir Fiber
1	**1000X1000**	**658.61**	**670**	**670**	**11.39**	**1.7**	**98.3**
2	**1000X1000**	**658.61**	**680**	**680**	**21.39**	**3.14**	**96.85**
Avg.	1000X1000	658.61	675	675	16.39	2.42	97.57

Table 18. Heavy Weight Non-Woven Coir Geo-Textile Composite (950 Grams/m²) after spraying with Natural Rubber with water Ratio of N.R. – Water – 1:4

Sl. No.	Sample Size (mm)	Initial weight coir felt	Weight after spraying	Density of Coir felt after	Weight of Rubber	% of Natural Rubber	% of Coir Fiber

		(grams)	the N.R. weight (grams)	spraying N.R grams/m2	(grams)		
1	**1000X1000**	**920**	**950**	**30**	**30**	**3.15**	**96.84**

Table 19. Resin Content for light weight, medium weight and heavy weight Non-Woven Coir Geo-Textile Composites impregnated with natural resin (1:1, 1:3 and 1:4)

SL. No.	Particular	% Resin (ratio 1:1)	% Resin (ratio 1:3)	% Resin (ratio 1:4)
1.	**Light Weight**	**8.00%**	**6.00%**	**2.12%**
2.	**Medium weight**	**14.01%**	**8.33%**	**2.42%**
3.	**Heavy weight**	**12.12%**	**7.07%**	**3.15%**

Table 20. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of PVA – Water 1:1)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying PVA (g)	Weight of PVA (g)	% of PVA	% of Fiber	Density after spraying PVA g/m²
1	**Light weight**	**320 X 310**	**41.71**	**50.00**	**8.29**	**16.58**	**83.42**	**504.03**
2	**Medium weight**	**310 X 300**	**78.71**	**91.80**	**13.09**	**14.25**	**85.74**	**987.09**
3	**Heavy weight**	**330 X 320**	**78.1**	**90.80**	**12.70**	**13.98**	**86.02**	**859.84**

Table 21. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of PVA – Water 1:2)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying PVA (g)	Weight of PVA (g)	% of PVA	% of Fiber	Density after spraying PVA g/m²
1	**Light weight**	**320 X 330**	**44.40**	**50.75**	**6.35**	**12.51**	**87.48**	**480.58**
2	**Medium weight**	**330 X 300**	**89.78**	**100.83**	**11.09**	**10.99**	**89.00**	**1018.48**
3	**Heavy weight**	**320 X 300**	**71.0**	**80.28**	**9.23**	**11.49**	**88.50**	**836.25**

Table 22. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of PVA – Water 1:3)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying PVA (g)	Weight of PVA (g)	% of PVA	% of Fiber	Density after spraying PVA g/m²
1	**Light weight**	**330 X 320**	**46.07**	**51.88**	**5.81**	**11.19**	**88.88**	**483.95**
2	**Medium weight**	**330 X 330**	**89.12**	**97.92**	**8.76**	**8.46**	**91.23**	**899.17**
3	**Heavy weight**	**335 X 320**	**80.28**	**87.3**	**7.02**	**8.04**	**91.95**	**814.36**

Table 23. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of PVA – Water 1:4)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying PVA (g)	Weight of PVA (g)	% of PVA	% of Fiber	Density after spraying PVA g/m²
1	**Light weight**	**310 X 310**	**45.40**	**50.59**	**5.19**	**10.25**	**89.74**	**526.43**
2	**Medium weight**	**320 X 310**	**83.95**	**91.0**	**7.05**	**7.74**	**92.25**	**917.33**
3	**Heavy weight**	**320 X 310**	**83.30**	**89.18**	**5.88**	**6.59**	**93.40**	**898.99**

Table 24. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of PVA – Water 1:6)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying PVA (g)	Weight of PVA (g)	% of PVA	% of Fiber	Density after spraying PVA g/m²
1	**Light weight**	**310 X 300**	**41.71**	**43.32**	**1.61**	**3.71**	**96.28**	**465.80**
2	**Medium weight**	**320 X 300**	**78.74**	**80.40**	**1.66**	**2.06**	**97.93**	**837.5**
3	**Heavy weight**	**330 X 305**	**78.10**	**81.05**	**2.95**	**3.63**	**96.36**	**805.26**

Table 25. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of PVA – Water 1:8)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying PVA (g)	Weight of PVA (g)	% of PVA	% of Fiber	Density after spraying PVA g/m²
1	**Light weight**	**320 X 300**	**41.78**	**44.32**	**2.54**	**5.73**	**94.26**	**461.66**
2	**Medium weight**	**310 X 300**	**85.62**	**87.87**	**2.25**	**2.60**	**97.39**	**944.83**
3	**Heavy weight**	**320 X 300**	**87.62**	**90.62**	**3.00**	**3.31**	**96.68**	**943.95**

Table 26. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 16 – Water 1:1)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 16 (g)	Weight of HA 16 (g)	% of HA 16	% of Fiber	Density after spraying HA 16 g/m²
1	**Light weight**	**330 X 310**	**46.03**	**66.765**	**20.735**	**31.05**	**68.94**	**652.63**
2	**Medium weight**	**310 X 310**	**91.29**	**98.089**	**6.799**	**6.93**	**93.06**	**1020.69**
3	**Heavy weight**	**320 X 310**	**94.24**	**102.289**	**8.04**	**7.86**	**92.13**	**1031.13**

Table 27. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 16 – Water 1:2)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 16 (g)	Weight of HA 16 (g)	% of HA 16	% of Fiber	Density after spraying HA 16 g/m²
1	**Light weight**	**320 X 310**	**41.86**	**58.72**	**16.85**	**28.69**	**71.30**	**591.93**
2	**Medium weight**	**330 X 320**	**86.4**	**102.24**	**15.84**	**15.49**	**84.15**	**968.18**
3	**Heavy weight**	**330 X 320**	**100.32**	**110.00**	**9.68**	**8.80**	**91.19**	**1041.66**

Table 28. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 16 – Water 1:3)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 16 (g)	Weight of HA 16 (g)	% of HA 16	% of Fiber	Density after spraying HA 16 g/m²
1	**Light weight**	**330 X 315**	**46.77**	**59.69**	**12.91**	**21.62**	**78.37**	**574.21**
2	**Medium weight**	**315 X 315**	**85.62**	**89.51**	**3.89**	**4.32**	**95.67**	**902.09**
3	**Heavy weight**	**320 X 315**	**86.97**	**92.10**	**5.13**	**5.58**	**94.41**	**913.69**

Table 29. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 16 – Water 1:4)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 16 (g)	Weight of HA 16 (g)	% of HA 16	% of Fiber	Density after spraying HA 16 g/m²
1	**Light weight**	**330 X 325**	**45.28**	**52.81**	**7.55**	**14.29**	**85.69**	**492.40**
2	**Medium weight**	**325 X 320**	**89.74**	**92.35**	**2.60**	**2.81**	**97.18**	**887.98**
3	**Heavy weight**	**320 X 315**	**86.97**	**105.29**	**18.32**	**17.39**	**82.60**	**1044.54**

Table 30. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 16 – Water 1:6)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 16 (g)	Weight of HA 16 (g)	% of HA 16	% of Fiber	Density after spraying HA 16 g/m²
1	**Light weight**	**315 X 310**	**43.94**	**48.68**	**4.73**	**9.71**	**90.28**	**498.51**
2	**Medium weight**	**310 X 310**	**87.61**	**91.40**	**3.78**	**4.31**	**95.68**	**951.09**
3	**Heavy weight**	**320 X 310**	**89.90**	**99.02**	**9.12**	**9.21**	**90.77**	**998.18**

Table 31. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 16 – Water 1:8)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 16 (g)	Weight of HA 16 (g)	% of HA 16	% of Fiber	Density after spraying HA 16 g/m²
1	**Light weight**	**310 X 310**	**40.10**	**41.99**	**1.89**	**4.50**	**95.49**	**436.94**
2	**Medium weight**	**320 X 320**	**86.75**	**92.22**	**5.47**	**5.93**	**94.06**	**900.58**
3	**Heavy weight**	**325 X 310**	**80.79**	**83.69**	**2.90**	**3.46**	**96.52**	**830.66**

Table 32. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 20 – Water 1:1)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 20 (g)	Weight of HA 20 (g)	% of HA 20	% of Fiber	Density after spraying HA 20 g/m²
1	**Light weight**	**340 X 320**	**48.95**	**70.995**	**22.04**	**31.04**	**68.95**	**652.52**
2	**Medium weight**	**310 X 310**	**91.29**	**97.727**	**6.437**	**6.586**	**93.40**	**1016.93**
3	**Heavy weight**	**320 X 320**	**97.27**	**112.678**	**15.40**	**13.66**	**86.33**	**1100.37**

Table 33. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 20 – Water 1:2)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 20 (g)	Weight of HA 20 (g)	% of HA 20	% of Fiber	Density after spraying HA 20 g/m²
1	**Light weight**	**320 X 310**	**41.86**	**61.34**	**19.54**	**31.85**	**68.13**	**618.34**
2	**Medium weight**	**330 X 310**	**86.66**	**103.61**	**16.94**	**16.34**	**83.65**	**1012.80**
3	**Heavy weight**	**320 X 310**	**84.03**	**113.08**	**29.05**	**25.68**	**74.31**	**1139.91**

Table 34. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 20 – Water 1:3)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 20 (g)	Weight of HA 20 (g)	% of HA 20	% of Fiber	Density after spraying HA 20 g/m²
1	**Light weight**	**320 X 310**	**41.86**	**50.38**	**8.52**	**16.93**	**83.06**	**507.05**
2	**Medium weight**	**320 X 310**	**84.03**	**89.00**	**4.97**	**5.58**	**94.41**	**897.17**
3	**Heavy weight**	**320 X 305**	**82.67**	**93.40**	**10.72**	**11.47**	**88.51**	**956.96**

Table 35. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 20 – Water 1:4)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 20 (g)	Weight of HA 20 (g)	% of HA 20	% of Fiber	Density after spraying HA 20 g/m²
1	**Light weight**	**345 X 320**	**47.58**	**61.39**	**13.81**	**22.49**	**77.50**	**556.06**
2	**Medium weight**	**335 X 325**	**84.03**	**88.32**	**4.29**	**4.857**	**45.13**	**811.20**
3	**Heavy weight**	**330 X 325**	**86.66**	**104.07**	**17.41**	**16.72**	**83.26**	**970.34**

Table 36. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 20 – Water 1:6)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 20 (g)	Weight of HA 20 (g)	% of HA 20	% of Fiber	Density after spraying HA 20 g/m²
1	**Light weight**	**315 X 310**	**40.55**	**51.33**	**10.77**	**20.48**	**79.01**	**525.65**
2	**Medium weight**	**320 X 310**	**90.35**	**90.35**	**6.32**	**6.99**	**93.00**	**910.78**
3	**Heavy weight**	**320 X 320**	**100.36**	**100.36**	**13.61**	**13.56**	**86.43**	**980.07**

Table 37. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 20 – Water 1:8)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 20 (g)	Weight of HA 20 (g)	% of HA 20	% of Fiber	Density after spraying HA 20 g/m²
1	**Light weight**	**320 X 310**	**44.86**	**57.36**	**12.50**	**21.74**	**87.49**	**578.22**
2	**Medium weight**	**310 X 310**	**84.03**	**89.03**	**5.0**	**5.61**	**94.38**	**926.43**
3	**Heavy weight**	**340 X 330**	**98.10**	**108.35**	**10.24**	**9.45**	**90.54**	**965.68**

Table 38. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 24 – Water 1:1)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 24 (g)	Weight of HA 24 (g)	% of HA 24	% of Fiber	Density after spraying HA 24 g/m²
1	**Light weight**	**320 X 320**	**46.07**	**51.236**	**11.16**	**21.78**	**78.21**	**500.35**
2	**Medium weight**	**320 X 320**	**97.27**	**101.603**	**4.33**	**4.26**	**95.73**	**992.21**
3	**Heavy weight**	**320 X 310**	**94.24**	**103.218**	**8.978**	**8.52**	**91.47**	**1040.50**

Table 39. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 24 – Water 1:2)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 24 (g)	Weight of HA 24 (g)	% of HA 24	% of Fiber	Density after spraying HA 24 g/m²
1	**Light weight**	**315 X 305**	**40.55**	**57.51**	**16.96**	**29.49**	**70.50**	**598.59**
2	**Medium weight**	**320 X 300**	**83.94**	**92.17**	**8.22**	**8.91**	**91.08**	**960.10**
3	**Heavy weight**	**325 X 310**	**88.09**	**106.25**	**18.15**	**17.08**	**82.41**	**1054.59**

Table 40. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 24 – Water 1:3)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 24 (g)	Weight of HA 24 (g)	% of HA 24	% of Fiber	Density after spraying HA 24 g/m²
1	**Light weight**	**325 X 305**	**40.55**	**52.80**	**12.25**	**23.20**	**76.79**	**532.66**
2	**Medium weight**	**315 X 310**	**80.38**	**89.25**	**8.87**	**9.93**	**90.06**	**913.97**
3	**Heavy weight**	**320 X 310**	**84.03**	**95.35**	**11.32**	**11.87**	**88.12**	**916.18**

Table 41. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 24 – Water 1:4)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 24 (g)	Weight of HA 24 (g)	% of HA 24	% of Fiber	Density after spraying HA 24 g/m²
1	**Light weight**	**320 X 315**	**45.35**	**48.00**	**2.64**	**5.5**	**94.49**	**476.19**
2	**Medium weight**	**320 X 300**	**78.74**	**85.23**	**6.49**	**7.61**	**92.38**	**887.81**
3	**Heavy weight**	**315 X 315**	**84.24**	**90.86**	**6.61**	**7.27**	**92.72**	**915.69**

Table 42. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 24 – Water 1:6)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 24 (g)	Weight of HA 24 (g)	% of HA 24	% of Fiber	Density after spraying HA 24 g/m²
1	**Light weight**	**320 X 305**	**43.91**	**46.55**	**2.63**	**5.64**	**94.34**	**476.94**
2	**Medium weight**	**345 X 310**	**90.83**	**95.22**	**4.38**	**4.59**	**95.40**	**890.32**
3	**Heavy weight**	**320 X 310**	**86.47**	**99.55**	**12.58**	**12.58**	**87.36**	**1003.52**

Table 43. Resin Content for Non-Woven Coir Geo-Textile Composite (Ratio of HA 24 – Water 1:8)

Sl. No.	Particular	Sample Size mm	Initial weight (g)	Weight after spraying HA 24 (g)	Weight of HA 24 (g)	% of HA 24	% of Fiber	Density after spraying HA 24 g/m²
1	**Light weight**	**320 X 315**	**48.34**	**52.83**	**4.49**	**8.49**	**91.5**	**524.10**
2	**Medium weight**	**325 X 315**	**84.24**	**88.30**	**4.06**	**4.59**	**95.4**	**862.51**
3	**Heavy weight**	**320 X 315**	**79.74**	**83.47**	**3.73**	**4.46**	**95.53**	**828.07**