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(54) **Title:** LIGHT-WEIGHT & HIGH STRENGTH NON-ASBESTOS CORRUGATED FIBER CEMENT ROOFING SHEETS MANUFACTURED BY AUTOCLAVE METHOD

(57) **Abstract:** Light weight & high strength non-asbestos corrugated fiber cement roofing sheets by autoclave method. A light weight and high strength non-asbestos conugated fiber cement roofing sheets comprising, Portland cement, pozzolonic material, fibrous reinforcing material, bentonite clay and additives wherein said fibrous reinforcing material is a combination of plurality of fibers having 8 to 20% of cellulose fiber, 0 to 3% of modified PET fibers and 0 to 6% other fibers optionally containing 0 to 3% rock wool/modified rock wool, organic fiber like jute, bamboo and mineral fibers selected from wollastonite modified or unmodified, sepiolite and mineral fiber.

TITLE:

Light weight & high strength non-asbestos corrugated fiber cement roofing sheets manufactured by autoclave method.

FIELD OF THE INVENTION:

The present invention relates to light weight & high strength non-asbestos corrugated fiber cement roofing sheets manufactured by autoclave method.

BACKGROUND OF THE INVENTION:

In the past asbestos-cement compositions have been formed into products such as flat sheets, corrugated sheets, boards, panels and the like. These sheets generally contained Portland cement in the amount of 43 to 55%, siliceous material and / or filler in the amount of about 30 to 35% and asbestos fibres in the amount of about 10 to 12%. The products had many desirable qualities, including high strength, exterior durability and easy application. Asbestos is a naturally occurring mining product. But day by day the availability of quality fibers

is reduced tremendously. Hence it is essential to develop corrugated sheeting product with alternative fibers with similar strength of asbestos based and cost effective.

Conventionally, the wood pulp and synthetic fibers such as Poly vinyl alcohol and modified poly propylene fibers has been used as an alternate to asbestos due to its unique characteristic of good dispersion in cementicious / water slurry because of its hydrophilic nature. These sheets generally contained Portland cement in the amount of 70 to 80%, siliceous material and / or filler in the amount of about 10 to 20% and synthetic fibers like poly vinyl alcohol, modified poly propylene and wood pulp in an amount of about 4 to 8%.

The above combination of fiber and fillers the end product can't be subjected for hydrothermal curing (autoclave) only Air cured/ water cured method to be adopted.

Indian Patent application 6305/CHE/2015 describes the manufacturing of non-asbestos corrugated sheet by auto clave method. In this invention, Asbestos

fibers were replaced with cotton pulp, modified or unmodified wollastonite and modified PET fiber. The part quantity of cement was replaced with GGBS slag and fly ash. In addition to this microsilica and additives are used.

US 4377415 relates to a cement-wollastonite product consisting essentially of Portland cement binder in an amount of between about 40% and 90% by weight, and wollastonite in an amount of between about 10% and 60% by weight. The product may contain fibers in an amount of between about 1% and 15% by weight. If the product contains fibers other than asbestos and is to be formed on a Hatschek or other type of wet forming machine, it may contain clay in an amount of between about 2% and 15% by weight, and poly(ethylene oxide) homopolymer in an amount of between about 0.03% and 0.5% by weight. The product may also contain silica and/or filler in an amount of between about 10% and 40% by weight for replacing part of the wollastonite. The filler may be waste fiber-cement product or inert filler material.

US8293003B1 teaches us a cement product incorporating nanocrystalline cellulose and cellulose fiber throughout the product and a method of making the product.

US5122550 relates to a non-asbestos friction material composition suitable for use as a friction element includes: a binder; a reinforcing material; and a structural integrity imparting amount of cellulose ester fibrils.

US6284815B1 teaches us a non-asbestos friction material is disclosed, which comprises a non-asbestos fibrous reinforcement, a thermosetting resin binder, and a filler as the main components, wherein the fibrous reinforcement is a combination of plural kinds of non-asbestos fibers and contains sepiolite fibers, cellulose fibers, and an acryl pulp as the fibrous reinforcement. The friction material of the present invention is excellent in fade characteristics, stability of effectiveness, etc., and low in cost.

US Patent 8182606B2 describes the manufacturing of low density fiber cement building materials by using low density additives such as hollow ceramic microspheres, volcanic ash (density : 2-25 lbs/cu.ft) and other low density additives either alone or in combination.

Australian patent 2008348271A1 illustrates the manufacturing of structural fiber cement building materials with density less than 1.25 g/cc & thickness less than

19 mm by using microspheres, calsil, polymeric beads, expanded vermiculite/perlite/shale and their combinations.

Indian Patent 279236 describes the manufacturing of light weight cementicious cellulose fiber reinforced building material without using any low density additives. In this invention flat fiber cement boards are manufactured by using bauxite and wood pulp by autoclave method.

In present invention to get the light weight and high strength of non-asbestos corrugated sheets an attempt has been made by increasing the pulp quantity and using high aspect ratio modified wollastonite.

An attempt has been made replace part or full quantity of PET fibers with alternative fibers like mineral fiber, sepiolite, Jute fiber, bamboo fiber etc.

A part quantity of Cellulose fiber (cotton pulp) has been replaced with modified rock wool fiber.

GGBS slag has been replaced with fly ash to reduce density and make the sheet lighter.

Similarly micro silica has been replaced with high surface area fly ash for cost reduction and addressing the processing problems by maintaining cone and sieve filtrate solids.

We have made use of bentonite to improve interlaminar bonding and replaced a part quantity of fly ash with fine ground silica and rice husk ash.
We have made use of anionic poly acrylamide flocculent by effective utilization of fine particle in the form of floccs.

A product replacing asbestos fibres and PVA fibers, silica and partly replacing cement with suitable materials makes it unique Green product in many ways. The present invention provides the method to manufacture of Light weight and high strength Non asbestos fiber cement corrugated sheet comprising of the processing reinforced fibers such as herein described

OBJECTS OF THE INVENTION:

An object of the present invention is to propose Light weight & high strength non-asbestos corrugated fiber cement roofing sheets manufactured by autoclave method.

Another object of the present invention is to replace asbestos fibers, wood pulp, PVA, modified Poly propylene fibers, micro silica and part replacement of cement to make it light weight and high strength Non Asbestos fiber cement corrugated roofing sheets.

Still another object of the present invention is to use more quantity of Cellulose fibers and high aspect ratio Wollastonite/modified wollastonite to replace asbestos fibers, Modified poly propylene and PVA fibers.

Further object of the present invention is to use sepiolite, mineral fibers, jute fiber and bamboo fiber to replace part quantity or full quantity of modified PET fibers.

Still further object of the present invention is to use modified rock wool fiber to part replacement of cotton rag pulp.

Still another object of the present invention is to make non-asbestos corrugated sheets with light weight by replacing GGBS with fly ash.

Yet another object of the present invention is to improve the bonding between the layer at green stage by incorporation of bentonite in the formulations.

One more object of the present invention is to maintain cone and sieve filtrate solids to address the process problems by replacing micro silica with high surface area fly ash, rice husk ash and fine ground silica.

Another object of the present invention is the effective utilization of fine particle in the form of floccs by adding anionic poly acrylamide flocculent.

Yet another object of the present invention is to reduce drying shrinkage of corrugated sheets produced by hydrothermal (Autoclaving) curing.

Another object of the present invention, is to propose a method of manufacturing building product with improved strength and other properties to the product manufacturing non-Asbestos fiber cement roofing sheet by autoclave method.

BRIEF DESCRIPTION OF THE INVENTION:

According to this invention there is provided light weight & high strength non-asbestos fiber cement corrugated roofing sheets comprising:

Portland cement, pozzolonic material, fibrous reinforcing material, bentonite clay and additives wherein said fibrous reinforcing material is a combination of plurality of fibers having 8 to 20% of cellulose fiber, 0 to 3% of modified PET fibers, and 0 to 6% other fibers optionally containing fibers mineral selected from wollastonite modified or unmodified, sepiolite and mineral fiber.

In accordance to this invention there is also provided a process for manufacturing light weight and high strength non-asbestos corrugated fiber cement roofing sheets comprising; preparing a slurry; subjecting the said slurry to the step of forming thin films, applying the said thin films on accumulator rolls, pre curing and curing in autoclave to produce the product.

DETAILED DESCRIPTION OF THE INVENTION:

The present invention relates to Non asbestos cement roofing fiber product by autoclave method which does not contains asbestos, PVA and virgin wood pulp, GGBS, and micro silica powder but which contains other fibers either alone in the combination of Cellulose, Modified PET Fibers, wollastonite/modified wollastonite, sepiolite, mineral fiber, jute fiber, bamboo fiber along with cement and siliceous material such as fly ash, fine ground silica and rice husk ash so as to permit satisfactory production thereof on a machine in which a slurry is formed on a screen and subsequently vacuum-filtered through a screen and or felt.

In the following paragraphs, wherein the term cellulose pulp is referred, it the cellulose pulp, which is obtained by mechanical pulping of waste jeans cotton rags or other natural cotton in loose or cloth form. Modified PET Fibers are having high molecular weight with good water dispersion and compatible with cement. Wollastonite is natural occurring mineral fiber having very good aspect ratio to attain strength and durability by reducing moisture movement. The

wollastonite is optionally modified with using additives such as Vinyl silane, Amino silane, glycidoxy silane and Vinyl acetoxy silane either alone or in combination. Due to this invention we have achieved the strength similar to asbestos based fiber cement sheets with light weight. Sepiolite is naturally occurring soft white clay mineral. Fibers texture of sepiolite makes it suitable for reinforcement. Jute and bamboo fiber are obtained from natural plants which are processed to suitable for fiber cement application. Mineral fibers is naturally occurring mining product.

Similarly wherein the fly ash is referred, it means the fly ash generated during the combustion of pulverized coal in the thermal power plant. Rice husk ash is an ash produced by controlled burning of grounded rice husk which contains amorphous silica.

Bentonite is also naturally occurring clay mineral which have very good swelling properties used to achieve the bonding between the layers.

In the following paragraphs, when inventor refers Non-asbestos fiber cement sheets, that is the new and invented non-asbestos fiber cement sheets which are

environment friendly products as is described in the present claim invention.

The process of the invention and its advantage will now be explained in greater detail with reference to the known method of manufacture of such sheets for clear and better understanding of the invention.

STEP 1- PREPARATION OF SLURRY

According to the present invention, an improved process for manufacture of Non Asbestos Cement Roofing Fiber cement sheets comprising of the processing reinforced fibers is provided.

The said reinforcing fibers essentially included Cellulose Pulp having fiber opening Deg.SR 12 – 50 used in an amount of 8-20%, modified PET fibers 0 to 3% and wollastonite/modified wollastonite is having the aspect ratio 5 to 40 in an amount of 0.25 to 10%, sepiolite 0-5%, mineral fibers 0-5%, jute fibers 0-5%, bamboo fibers 0-5%, modified rock wool fiber 0-5%, Portland cement in an amount of 20 to 55%, Siliceous material in the binder essentially pulverized fly ash having surface area of 2000-4000 cm^2/gm used in an amount of 15 – 55%,

fine fly ash having surface area of above 4000 cm^2/gm used in an amount of 20 – 60%, rice husk ash having surface area of greater than 5000 cm^2/gm used in an amount of 0-20%, fine ground silica used in an amount of 0 to 25% and bentonite used in an amount of 1-5% and fillers, flocculent and additives in an amount of 0.01 to 2% by weight of the total mixing comprising or the reinforcing fibers, cement, fillers and additives.

While making slurry, care was taken to ensure there was homogeneous mixing of siliceous material, additives and cement with reinforcing fibers.

Mixing/holding system ensured that solids are not separated from the aqueous solution, i.e. solids do not settle so that the lamination having uniform distribution of the binder and the reinforcing fibers is obtained in the process.

STEP 2: APPLICATION OF SLURRY

The recipe thus obtained in respect of the above formulations were independently run on pilot plant and plant sheet forming machine such as HATSCHECK MACHINE where thin films are picked up and superimposed on

accumulator roll. The composite is cut upon after building up to desired thickness and laid flat and or conveyed for corrugation and stacking before pre curing. Over a period of time and at predetermined temperature, the initial curing in the composite make it strong and acquire enough strength for demoulding.

STEP 3: CURING THE ARRANGED PRODUCT.

Demoulded corrugated sheets are then arranged on a trolley and cured under Autoclave maintaining the steam pressure for 90 to 130psi and duration of 5 to 15 hours. After curing is over, cured material in the trolleys is pulled out and stacked in ambient condition for further inspection and dispatch.

EXAMPLES

Using the above said slurry and process of manufacturing the claimed light weight & high strength Non Asbestos Fiber Cement corrugated Roofing sheet, the various trials were conducted in order to replace the Asbestos fibers, PVA fibers, GGBS, micro silica and part replacement of cement with fly ash. Some typical examples and test results are as follows:

Table 1 Present invention – Plant trials

Raw – Material	% of raw materials used					
	Conventional Asbestos corrugated sheets	Indian patent application 6305/CHE/ 2015	Present invention			
			Example 1	Example 2	Example 3	Example 4
Ordinary Portland cement	43-55	20 to 55	20-60	20-60	20-60	20-60
Pulverized fly ash SSA : 2000-4000 cm^2/gm	30-35	15 to 50	15-55	15-55	-	-
Fine fly ash SSA : above 4000 cm^2/gm	-	-	-	-	25-50	25-50
Asbestos fibers	10-12	-	-	-	-	-
Ground granulated blast furnace slag	5-10	2 to 20	-	-	-	
Jeans cotton rag	-	3 to 15	8-20	8-20	8-20	8-20
PET Fibers		0.25 to 6	0.2-3	0.2-3	0.2-3	0.2-3

Modified/unmodified wollastonite Aspect ratio : 5-10	-	0.25 to 6	0.2-6	-	0.2-6	-
Modified/unmodified wollastonite Aspect ratio : Above 10	-	-	-	0.2-6	-	0.2-6
Micro silica		0.25 to 5	-	-	-	-
Bentonite	-	-	1 to 5	1 to 5	1 to 5	1 to 5
Additives	0.25 to 5	0.25 to 5	0.01 to 2	0.01 to 2	0.01 to 2	0.01 to 2
Total	100	100	100	100	100	100
Properties – Pilot plant trial						
Size	Lengthxwidthxthickness 1270 x 575 x 6 mm					
Density	1.39	1.13	1.05	1.12	1.16	1.2
Load bearing capacity	267	271	250	265	280	293
Water absorption %	33.0	42.8	44.37	47.56	40.75	43.4
Properties – Plant trial						
Size	Lengthxwidthxthickness 2500 x 1050 x 6 mm					
Density	1.41	-	1.07	1.09	1.05	1.07
Load bearing capacity IS 5913 Span : 1000 mm	550	-	408	430	525	600
Load bearing capacity IS 14871 Span : 1100 mm	NA	-	380	410	475	520

By using fine fly ash and high aspect ratio modified/unmodified wollastonite in example 4 achieved the superior properties compared to conventional asbestos and non-asbestos fiber cement corrugated roofing sheets. The invented product meeting all the

requirements of IS 14871:2000 Indian standard and International standard of ISO 9933: 1995.

Type Tests performance:

1) Water impermeability: No water droplets observed after 24 hours underneath of the corrugated sheet.
2) Frost Resistance: The corrugated sheets are subjected freeze thaw cycles cooling to -20°C within 1 to 2 hours and holding for 1 hours. Thawing in water to ambient temperature within 1 to 2 hours and holding for 1 hour. After 50 cycles, there is no cracks, delamination and color change observed.
3) Heat & Rain: The corrugated sheets are subjected to wetting 2.5l/min/m2 for 2 hour 50 minutes and heating to 70°C for 2hour 50 minutes with an interval of 10 minutes each. The cycle is repeated for 25 times and examined for longitudinal and transverse cracks, visual defects, color change and delamination. The exposed sheets are passed the tests.
4) Warm Water: The specimens are exposed to warm water having temperature 60°C for 56 days and exposed sheets are meeting standard requirement.
5) Soak & dry: The tests are carried out as per EN 494 : 2004 (Immersion in water for 18 hours at ambient temperature and dry at oven for 60°C and relative humidity < 20% for 6 hours for every cycle). After 50 cycles sheets kept at ambient temperature for 7 days and tests are carried out which is meeting standard requirement.
6) Carbonization test: The carbonization each cycle is 24 hours which is consist of following: 9 hrs immersion in water at ambient, 1 hr dry in ventilated oven at 60°C, 5hrs purging CO2 at ambient temperature, 8 hours dry in ventilated oven at 60°C and cooling to ambient temperature within 1 hour time. The specimens are subjected to expose for 50 cycles. No visual defect cracks are observed.

Table 2. Present invention – pilot plant trials

Raw – Material	% of raw materials used					
	Present invention					
	Example 5	Example 6	Example 7	Example 8	Example 9	Example 10
Ordinary Portland cement	20-60	20-60	20-60	20-60	20-60	20-60
Pulverized fly ash SSA : 2000-4000 cm^2/gm	15-55	15-35	15-55	15-55	15-55	15-55
Jeans cotton rag	4-12	8-20	8-20	8-20	8-20	8-20
PET Fibers	0.1-6	0-6	0-6	0-6	0-6	0-6
Modified/unmodified wollastonite	0-6	0-6	0-6	0-6	0-6	0-6
Micro silica	-	-	-	-	-	-
Bentonite	1 to 5	1 to 5	1 to 5	1 to 5	1 to 5	1 to 5
Modified rock wool fiber	0.1 to 5	-	-	-	-	-
Sepiolite fiber	-	-	-	0.1 to 5	-	-
Mineral fiber	-	-	-	-	0.1 to 5	-
Jute/Bamboo fiber	-	-	-	-	-	0.1 to 5
Rice husk ash	-	2-20	-	-	-	-
Ground fine silica	-	-	5-25	-	-	-
Additives	0.01 to 2	0.01 to 2	0.01 to 2	0.01 to 2	0.01 to 2	0.01 to 2
Total	100	100	100	100	100	100
Properties – Pilot plant trial						
Size: Lengthxwidthxthickness 1270 x 575 x 6 mm						
Density	1.06	1.06	1.13	1.15	1.11	1.06
Load bearing capacity	225	262	243	277	308	293
Water absorption %	46.1	47.9	42.6	43.9	47.5	45.8

Rock wool fibers are used in example 5 for part replacing jeans cotton rag pulp. Rice husk ash and ground fine silica are used as a part replacement for pulverized fly ash in Example 6 and 7 respectively. Sepiolite, mineral fiber, jute/bamboo fibers are used as part or full replacement of modified PET fibers in examples 8,9 and 10 respectively.

It has been determined by way of compression of the invented light weight & high strength non-asbestos fiber cement corrugated roofing sheets produced by autoclave method in this invention are having better load bearing capacity than that of conventional asbestos and non-asbestos fiber cement corrugated roofing sheets. .

WE CLAIM:

1. A light weight and high strength non-asbestos corrugated fiber cement roofing sheets comprising, Portland cement, pozzolonic/filler material, fibrous reinforcing material, bentonite clay and additives wherein said fibrous reinforcing material is a combination of plurality of fibers having 8 to 20% of cellulose fiber, 0 to 3% of modified PET fibers,0 to 3 % rock wool/modified rock wool fibers and 0 to 6% other fibers optionally containing organic fibers like jute & bamboo and mining fibers selected from wollastonite modified or unmodified, sepiolite, and mineral fiber.

2. A light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1, wherein wollastonite is optionally modified with additive such as Vinyl silane, Amino silane, glycidoxy silane and Vinyl acetoxy silane either alone or in combination in an amount of 0.1 to 3% of wollastonite weight.

3. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1, wherein the said pozzolonic material is selected from pulverized fly ash, fine fly ash, rice husk ash, fumed silica , volcanic ash and optionally ground granulated blast furnace slag.

4. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1, wherein siliceous material like ground fine silica is optionally used in an amount of 5 to 25% by weight.

5. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1, wherein the said Bentonite is an amount of 1 to 5% by weight.

6. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1, wherein the said additives is present in an amount of 0.01 to 2%.

7. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1 wherein the said cellulose fiber is selected from jeans cotton rag, waste cotton, virgin cotton used alone or in combination.

8. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1 wherein wood pulp optionally can be used along with said cellulose fiber selected from jeans cotton rag, waste cotton, virgin cotton used alone or in combination

9. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets wherein the length of sepiolite used is in range of 1-25 mm and wollastonite has the aspect ratio 5 to 50.

10. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1 wherein the pulverized fly ash used has a fineness of 2000-4000 cm^2.gm, in an amount of 15 – 55% by weight.

11. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1 wherein the fine fly ash has surface area of above 4000 cm^2/g in an amount of 25 -50%.

12. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1 wherein the additives used are pan gel, plasticizers, superplasticizers, flocculating agents, defoamers, water reducing admixtures of silicone or acrylic base in an amount of 0.01 to 2% by weight.

13. The light weight and high strength non-asbestos corrugated fiber cement roofing sheets as claimed in claim 1, wherein the other fibers are selected from jute fibers, bamboo fibers, sepiolite, ceramic fibers, Glass fibers, mineral fibers, mineral wool and ceramic wool along with cotton pulp.

14. We claim that the compositions claimed in claims 1 to 13 can also be used for making non asbestos fiber cement flat sheets/boards.

15. A process for manufacturing light weight and high strength non-asbestos corrugated fiber cement roofing sheets comprising; preparing a slurry; subjecting the said slurry to the step of forming thin films, applying the said thin films on accumulator rolls, pre curing and curing in autoclave to produce the product.

16. The process as claimed in claim 1, wherein the said slurry is a homogeneous mixture of silicones material, additives and cement with reinforcing fibers.

17. The process as claimed in claim 1, wherein the step of curing is carried out under autoclave maintaining the steam pressure 90 to 130 psi for 5 to 15 hours.

18. A process as claimed in claims 1 to 5, wherein the said reinforcing fibers is Cellulose pulp preferably processed to opening Deg.SR 12-50 and has Length weighted average fiber length lot 0.7 to 2.9 mm.

AMENDED CLAIMS
received by the International Bureau on 10 August 2018 (10.08.2018)

WE CLAIM:

1. A light weight and high strength non-asbestos corrugated fiber cement roofing sheets comprising :

i) 20 to 60% by wt. of Ordinary Portland cement,

ii) 20-60% by wt.of pozzolonic material

iii) 8-20% by wt. of cellulose fibers as reinforcing material

iv) 1-5% by wt. of bentonite clay

v) 0.1-3% by wt.of modified PET fibers

vi) 0.2-.6 % by wt. of modified/unmodified wollastonite

vii) 0.01-2% by wt. of additives and

viii) Optionally 0.1 to 6% by wt. of other fibers selected from rock wool, jute fibers, bamboo fibers, sepiolite, ceramic fibers, Glass fibers, mineral fibers, mineral wool and ceramic wool are used either alone or in combination along with cellulose fibers to replace (partial or full) modified wollastonite and modified PET fibers

Wherein the density of said product is less than 1200Kg/M3.

2. The product as claimed in claim 1 wherein preferably ordinary Portland cement is present in the range of 35-50% by wt, pozzolonic material is present in the range of 35-50% by wt., cellulose fibers is present in the range of 10-16% by wt, bentonite clay is present in the range of 1.5-3% by wt., modified PET fibers is present in the range of 0.2-1% by wt., modified/unmodified wollastonite is present in the range of 2-6% by wt,

3.The product as claimed in claim 1, wherein wollastonite is modified with Vinyl silane, Amino silane, glycidoxy silane and Vinyl acetoxy silane either alone or in combination, in an amount of 0.1 to 3% of wollastonite weight., said silanes help in bridging between organic and inorganic materials.

4.The product as claimed in claim 1, wherein the said pozzolonic material is selected from pulverized fly ash, fine fly ash, rice husk ash, fumed silica, volcanic ash and optionally ground granulated blast furnace slag.

5.The product as claimed in claim 1, wherein optionally 5 to 25% by wt. of siliceous material like ground fine silica is used to partially replace fly ash.

6,The product as claimed in claim 1, wherein the said cellulose fiber is selected from jeans cotton rag, waste cotton and virgin cotton.

7.The product as claimed in claim 1, wherein wood pulp optionally can be used along with said cellulose fiber selected from jeans cotton rag, waste cotton, virgin cotton used alone or in combination

8.The product as claimed in claim 1, wherein wollastonite/modified wollastonite has the aspect ratio 5 to 50.

9.The product as claimed in claim 1, wherein the additives used are pan gel, plasticizers, superplasticizers, flocculating agents, defoamers, water reducing admixtures of silicones or acrylic base.

10. The product as claimed in claim 1 -9, can also be used for manufacture of non-asbestos flat sheets/boards.

11. A process for manufacturing light weight and high strength non-asbestos corrugated fiber cement roofing sheets consists of ;

a) preparation of slurry

b) subjecting the said slurry to the step of forming thin films by Hatscheck process

c) applying the said thin films on accumulator rolls

d) after reaching desired thickness the flat sheet is cut from accumulator roller

f) Flat sheet is profiled to desired corrugation

g) pre curing and de-stacking

h) curing in autoclave

12. The process as claimed in claim 11, wherein the said slurry is a homogeneous mixture of Siliceous material, Portland cement, reinforcing fibers, Bentonite and additives.

13. The process as claimed in claim 11, wherein the step of curing is carried out under autoclave maintaining the steam pressure 90 to 130 psi for 5 to 15 hours.

14. A process as claimed in claims 11 to 13, wherein the said reinforcing fibers is Cellulose pulp preferably processed to opening Deg.SR 12-50 and has Length weighted average fiber length lot 0.7 to 2.9 mm.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2017/050541

A. CLASSIFICATION OF SUBJECT MATTER
INV. C04B28/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C04B E04D E04B E04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 482 550 A (STRAIT MARK C [US]) 9 January 1996 (1996-01-09) column 3, line 58 - column 11, line 45; claims 1-4; examples I-VII -----	14
X	EP 0 068 741 A1 (CAPE UNIVERSAL CLADDINGS [GB]; CAPE BOARDS & PANELS LTD [GB]) 5 January 1983 (1983-01-05) page 2, line 4 - page 4, line 21; claims 1-24; examples 1,3 page 3, line 25 - page 4, line 16 -----	1-13, 15-18
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
4 June 2018	11/06/2018

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

International application No
PCT/IN2017/050541

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