

GLASS REINFORCED CEMENT (GRC) SHEETS/PLATES

The subject of this application relates to a mold and automatic plant arrangement for manufacturing glass reinforced cement (GRC) sheets/plates by compressing and method for manufacturing these.

The related technical field and state of the art is as follows.

Currently many different methods are used for producing fibered plates. Until recently asbestos has been used with these methods but now use of AR Glass fibers begun. Same methods and apparatuses used in asbestos plate manufacturing are used in fiber composites. Main methods are: Magnani, Hatschek, Procem, Bell and Wellcrete systems. They are basically same systems with small differences among them. Removing of excess mortar water is done by upward or downward vacuum systems and large diameter perforated cylinders are used. Fiber reinforced composite plate can by no means be given a finished shape or form. For producing finished formed plates press have to be used and material has to be compressed in a mold. When press is used it is impossible to remove compressed material from the mold. The material have to stay in the female mold in the press until it sets, and under best conditions in spite of using additional processes such as using various setting accelerating chemicals and heating up; this is not possible in less than 5 hours. And this does not enable automation, moreover it is not economical.

The object of the present invention and solutions it contains for the above mentioned problems are as follows:

1. Providing finished shaped and formed plates which are impossible to produce by automatic or semi-automatic systems,
2. For this purpose providing use of press in composite or fiber plate-sheet production,
- 5 3. For this purpose providing automation by semi belt system in GRC plate production with pressing,
4. Providing overlapping and fitting systems over finished sheets/plates which can not be formed in corrugated and smooth fiber plates produced by present techniques,
- 10 5. In terms of mold pattern and method the subject of the invention is to provide resistance and strength by forming ribs on back of finished sheets/plates which can not be formed in corrugated and smooth fiber plates produced by present techniques,

15 Description Of the Drawings

Figure 1: Press outer female mold (Figure 1-A).

Figure 2: Placing of thin inner female mold tray (Figure 2-B) which is formed by compressing in female mold, in female mold.

20 **Figure 3:** Spraying of fiber reinforced GRC composite mortar inside female mold tray by a Concentric Spray Gun (Figure 3-E).

Figure 4: holes (Figure 4-R) on male mold which are used to remove excess water.

Figure 5: (Figure 5-D) Pressing and locking of inner female tray over male mold (Figure 5-F).

25 **Figure 6:** Removal of male mold together with inner female mold from female mold.

Figure 7: Placing of inner female mold tray on Conveyor (Figure 7-K).

Figure 8-9: forming of overlapping (Figure 8-M, Figure 9-N) and fitting (Figure 9-N) systems between plates.

5 **Figure 10:** Front view of a profiled smooth plate.

Figure 11: View of the ribs (Figure 11-P) that are formed on the back of the profiled plate.

Figure 12: Main features of an automatic plate production.

10 **Description Of The Invention**

Depending on architectural plan and design required FIBER REINFORCED CEMENT SHEET/PLATE may have any requested shape, form and detail such as roof plate, window post, storey cornice, wooden look various patterned wall lining, stone texture, brick texture
15 and so on. Such shaped/formed finished standard plate/sheet production is not possible with present automation methods.

In our invention, in a female mold (Figure 1-A) prepared in requested form/shape/detail there is placed one of inner thin female mold trays which was also compressed in the same form/shape/detail
20 (Figure 2-B). Forming and using a female mold tray (B) between these molds, wherein GRC mortar is to be placed, compressed and then carried together with a female mold tray and left to take its setting, is not familiar to the present state of the art.

Inside this mold tray (B), which is put in a female mold, GRC
25 cement mortar is (C) placed either by an automatic concentric spray gun (E) or by spraying (Figure 5,6,7-C).

Mold arrangement and production method according to the invention comprises the following characteristics which are not familiar to the present state of the art:

1. 2-3 mm diameter and 10 cm spaced holes were opened on male mold (Figure 4). Excess mortar water is provided to be removed from these holes (de-watering).

2. There is provided sides, fittings, overlappings (Figure 8-M, Figures 9-N and L) and ribs (Figure 4-O, 11-P) with requested shape, form and detail on finished sheet/plate's surface and back by means of fitting spaces (Figure 8-M and Figure 9-N and L), ribs (Figure 11-P) with requested shape, form and detail formed as female on inner side of male mold (Figure 4-O).

3. There is provided the inner female mold tray's sides to lock (Figure 5-F) to the male sides. In this way when press male mold is lifted, removal of thin inner female mold tray (Figure 3-B and C), which is filled with GRC mortar and pressed, together with male mold is enabled.

After male mold (Figure 5,6-D) is compressed, female inner mold tray (B) is locked to male mold (Figure 5-F), excess mortar water is removed from the holes (Figure 4) on male mold. Press male mold is lifted together with inner female mold tray which is locked to it, press head is turned and thus male mold block carrying female mold tray is brought to conveyor (Figure 6).

Locks of inner mold tray is opened and inner female mold tray carrying composite, GRC cement plate (C) is released over conveyor (Figure 7) and sent to steam treating.

A new inner female mold tray (B) is placed in female mold (A) and this successive process is repeated. This process is run in a semi-automatic way.

Also an automatic plant arrangement (Figure 12) is shown.

- 5 Empty inner female mold tray (Figure 12-b) moving on conveyor comes to spray station, GRC cement mortar is sprayed into inner female mold tray by automatic spray (Figure 12-C). Inner female mold filled with GRC cement mortar resides its place on female mold (Figure 12-d). Full inner female mold tray containing compressed
- 10 material after compression lifts up with male mold of press (Figure 12-e). Male mold block of press moves forward and comes over conveyor (Figure 12-f). Full inner female mold tray (Figure 12-g) carrying the compressed material released on conveyor is introduced to treating chamber.

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CLAIMS

1. A mold and an automatic plant arrangement for producing fiber reinforced GRC formed sheet/plate by compressing, characterized in that it comprises a thin inner female mold tray in which compressed mortar is placed and which enables compressed mortar to be removed immediately until it sets and hardens.

2. A mold and an automatic plant arrangement for producing formed sheet/plate by compressing according to claim 1, characterized in that thin inner female mold tray (Figure 2-B) which is placed in press outer female mold (Figure 1-A) is prepared by compressing with same form, shape and detail with press outer female mold (Figure 1-A).

3. A mold and an automatic plant arrangement for producing formed sheet/plate by compressing according to any of the preceding claims, characterized in that excess water removal is provided by holes (Figure 4-) on male press mold.

4. A mold and an automatic plant arrangement for producing formed sheet/plate by compressing according to any of the preceding claims, characterized in that there is provided sides, fittings, overlappings (Figure 8-M, Figures 9-N and L) and ribs (Figure 4-O, 11-P) with requested shape, form and detail on finished formed sheet/plate's surface and back by means of fitting spaces (Figure 8-M and Figure 9-N and L), ribs (Figure 11-P) with requested shape, form and detail formed as female on inner side of male mold (Figure 4-O).

5. A mold and an automatic plant arrangement for producing formed sheet/plate by compressing according to any of the preceding claims, characterized in that it comprises lock system (Figure 5-F)





which provides sides of thin inner female mold tray (B) to lock on male mold sides (D) in order to enable thin inner mold tray (Figure 3 B and C) to be removed with male mold (Figure 6) from female mold (A).

5 6. A mold and an automatic plant arrangement for producing formed sheet/plate by compressing according to any of the preceding claims, characterized in that it comprises placing a thin inner female mold tray (Figure 2-B) compressed in same form/shape in press outer female mold (Figure 1-A), putting GRC mortar inside this thin inner
10 female mold tray and compressing it, immediately after compressing process removing (Figure 6) thin inner female mold tray (B) in which there is compressed GRC mortar together with male mold from outer female mold and introducing (Figure 7) to treatment chamber and thus compressed GRC mortar getting a shape, setting and hardening inside
15 thin inner female mold tray, and providing automation by repeating the same process as shown in Figure 12 by placing a new inner female mold tray in emptied press mold.

 7. A mold and an automatic plant arrangement for producing formed sheet/plate by compressing according to any of the preceding
20 claims, characterized in that it comprises:

a) preparing a press female mold (Figure 1-A) in order to obtain formed sheet/plate with requested shape, form and detail depending on architectural plan and design;

b) forming a thin inner mold tray (Figure 2-B) with same shape,
25 form and detail by compressing in outer female mold;

c) placing the thin inner mold tray inside outer female mold (Figure 2-A and B);

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- d) placing fiber reinforced GRC composite mortar in the female mold tray by spraying of it (Figure 3-C);
- e) compressing fiber reinforced composite mortar in the thin inner female mold tray by means of male mold (Figure 4);
- 5 f) after compressing, locking the thin inner female mold tray containing compressed GRC mortar to the male mold (Figure 5);
- g) removing thin inner female mold tray containing compressed GRC mortar together with male mold from outer female mold (Figure 6);
- 10 h) removing thin inner female mold tray containing compresses GRC mortar and introducing it to treatment chamber by conveyor;
- i) removing finished formed sheet/plate (C) comprised of set and hardened GRC in treatment chamber from thin inner mold tray (B) and preparing for use.
- 15 8. A mold and an automatic plant arrangement for producing formed sheet/plate by compressing according to any of the preceding claims, characterized in that it enables formed sheet/plate with requested shape, form and detail depending on architectural plan and design.

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AMENDED CLAIMS

[received by the International Bureau on 12 June 1998 (12.06.98);
original claims 1-8 replaced by new claims 1-8 (4 pages)]



1. A mold and an automatic plant arrangement for producing fiber reinforced GRC formed sheet/wall panel/roofing by compressing, characterized in that it comprises a thin inner female mold tray (Figure 2-B) in which compressed GRC mortar is placed and which is locked to the upper male press mold (Figure 5-F) and removed immediately from press outer female mold together with the upper male press mold, until the compressed mortar sets and hardens.

2. A mold and an automatic plant arrangement for producing GRC formed sheet/wall panel/roofing by compressing according to claim 1, characterized in that the thin inner female mold tray (Figure 2-B), which is placed in the outer female mold (Figure 1-A) and can be locked to the upper male mold (Figure 5-F), is made of a rigid material suitable for large-size panel production.

3. A mold and an automatic plant arrangement for producing GRC formed sheet/wall panel/roofing by compressing according to any of the preceding claims, characterized in that excess water removal in GRC mortar (de-watering) is provided by holes (Figure 4-R) on upper male press mold.

4. A mold and an automatic plant arrangement for producing GRC formed sheet/ wall panel/roofing by compressing according to any of the preceding claims, characterized in that sides, fittings, overlappings (Figure 8-M, Figures 9-N and L) and ribs (Figure 11-P) with requested shape, form and detail are provided on both front and back surfaces of the finished sheet/ wall panel/roofing by means of sides, fittings, overlappings and ribs with requested shape, form and detail formed as female on inner side of upper male mold (Figure 4-O).



5. A mold and an automatic plant arrangement for producing GRC formed sheet/ wall panel/roofing by compressing according to any of the preceding claims, characterized in that it comprises lock system (Figure 5-F) which provides sides of thin inner female mold tray (B) to lock on male mold sides (D) in order to enable thin inner mold tray (Figure 3 B and C) to be removed with male mold (Figure 6) from female mold (A).

6. A mold and an automatic plant arrangement for producing GRC formed sheet/ wall panel/roofing by compressing according to any of the preceding claims, characterized in that it comprises placing a thin inner female mold tray (Figure 2-B) compressed in same form/shape in press outer female mold (Figure 1-A), putting GRC mortar inside this thin inner female mold tray and compressing it, immediately after compressing process removing (Figure 6) thin inner female mold tray (B), in which there is compressed GRC mortar and which has been locked to the upper male mold (Figure 5-F) during compressing, together with upper male mold to which it is locked from outer female mold and introducing (Figure 7) to treatment chamber and thus compressed GRC mortar getting a shape, setting and hardening inside thin inner female mold tray, and providing automation by repeating the same process as shown in Figure 12 by placing a new inner female mold tray in emptied press mold.

7. A mold and an automatic plant arrangement for producing GRC formed sheet/ wall panel/roofing by compressing according to any of the preceding claims, characterized in that it comprises:

a) preparing a press outer female mold (Figure 1-A) in order to obtain sheet/wall panel/roofing with requested shape, form and detail depending on architectural plan and design;



- b)* forming a thin inner mold tray (Figure 2-B) with same shape, form and detail by compressing in outer female mold;
- c)* placing the thin inner mold tray inside outer female mold (Figure 2-A and B);
- d)* placing or spraying fiber reinforced GRC composite mortar in the female mold tray (Figure 3-C);
- e)* compressing fiber reinforced composite mortar in the thin inner female mold tray by means of male mold (Figure 4);
- f)* removing excess water of the concrete (de-watering) during compressing via specific holes on the upper male mold (Figure 4-R) and discharge thereof by a particular arrangement;
- g)* after compressing, locking the thin inner female mold tray containing compressed GRC mortar to the male mold (Figure 5);
- h)* removing thin inner female mold tray containing compressed GRC mortar together with male mold to which it has been locked from outer female mold (Figure 6);
- i)* removing thin inner female mold tray containing compresses GRC mortar from the male mold and introducing it to treatment chamber by conveyor;
- j)* treating the rigid thin inner female mold trays introduced to the treatment chamber by lining them up with a particular arrangement;
- k)* removing finished sheet/wall panel/roofing(C) comprised of set and hardened GRC in treatment chamber from thin inner mold tray (B) and preparing for use;
- l)* providing automation for above explained processes by immediately placing another inner female mold tray in the outer female mold after the first thin inner female mold tray is removed from the female mold



together with the upper male mold to which it has been locked, and a plant arrangement therefor.

8. Production method, mold design and plant arrangement which have the suitable structure and size for providing automation in producing GRC formed large-size sheet/wall pane/roofing by compressing according to any of the preceding claims, characterized in that they enable the production of GRC formed sheet/ wall panel/roofing with requested shape, form and detail depending on architectural plan and design which cannot be produced by systems known in the art automatically producing concrete elements.

