



Research Article

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## Development of machinery equipment for magnesia corrugated tile

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### ABSTRACT

For getting the substitute of asbestos products producing line, the structure of mechanized equipments for magnesia corrugated tiles was described, and the manufacturing process was also analyzed. According to calculate and analyze, the process shortage was given, and the solved methods were also found out.

**Keywords:** Mechanized equipment for magnesia corrugated tile; Feeding machine; Hopper nozzle.

### INTRODUCTION

With the developing of the social productivity, the standard of people's living has raised continuously, and the knowing for the life value of human also has deepened. Generally, people used the asbestos products in the past. Because of the fatal shortage that is harmful for people, it is forbidden to use gradually. Then, every country is searching for an appropriate substitute<sup>[1-2]</sup>. After long researching and studying, we found a new process of producing corrugated tile added the long glass fiber into the magnesia cement<sup>[1]</sup>. The corrugated tile made by magnesia cement, which is used the new process, it can fully stand for the asbestos cement, it also has a better performance than the old asbestos corrugated tile. We also found the producing line of magnesia corrugated tile through long time, therefore, the producing line proved by testing has the feature that is easy to operate, reliable to work, efficient to produce, convenient to repair, good to adapt to the process and so on. It not only can be used to produce the corrugated tile, but also can be used to produce the magnesia decorative board<sup>[2,3]</sup>.

### EXPERIMENTAL SECTION

#### 1 The working principle and design parameters of the equipment

##### The structure of the magnesia corrugated tile cement

The detail structure draw of the magnesia corrugated tile cement is shown as Figure 1. It consists of magnesia cement, which places on top, center, bottom layers, and there are two layers of glass fiber nets tucked inside. The function of glass fiber nets is used as frame to increase the strength and rigidity.

##### The working principle of the production line for claying the magnesia cement corrugated tiles

This production line is made of various materials stirring into a magnesia inorganic gel according to certain process recipe. Firstly, the automatic composite system will composite the three uniformed gel and two layers of glass fiber grid cloth into a flat tile billet which thickness is 6 mm, then after a fixed-length cutting system, it will continually composite tile billet in a certain length of crosscutting into individual tile billet. Second, by conveying raceway, the tile billet along with tile template are both directly sent to pressure forming machine, tile billet then will be pressed into similar corrugated tiles of the model, and finally through the conveying groove type stacker, it removes the corrugated tiles along with the template from the production line to maintenance and transmission of raceway, then the product is released from the mold, cut, packaged into warehousing.

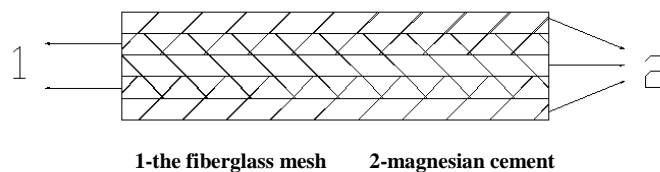


Figure 1: The structure of the magnesia corrugated tile cement

## 2 Equipment process and the function of several main parts

The process diagram of the device is shown as Figure 2.

The function of several main parts are as following:

1) Raw material conveying measurement system: The system is mainly for the deployment of the medicament and the measurement of each raw material composition. In order to reduce all kinds of the powder dust pollution to the environment, the sealing pipe to convey, screw feeder to feed, electronic scales to measure are adopted.

2) Pulp conveying system: Raw materials prepared by the measuring system will be joined into a blender according to certain procedures, After stirring the raw material, it uses the screw pump conveying slurry to automatic composite host.

3) Automatic composite host: Its role is to composite two layers of glass fiber cloth continuously, three layers of slurry and two layers of plastic sheeting into slab thickness of clip cloth. It is driven by the motor through the reducer driver to drive roller rotating. And the slurry is driven well-proportioned by the two layers of glass fiber grid cloth. The tile billet is dragged by the friction between tile billet and the roller continuously and the tile billet weights itself, the thickness is controlled by the rolling roller and plastic roller.

4) Fixed-length slab sheared: Tile billet tablet coming from the automatic composite host continuously is cut into tile billet which thickness is about 1890 mm, it is controlled by the electric hydraulic of the sizing roller and the cutting trolley which moves toward the speed synthesis direction and it can fix cutting seam neatly.

5) Corrugated straight molding system: Since the waveforms of magnesia cement tile can be formed by the straight pressure. But the billet tiles of magnesia cement have good plasticity, then the straight pressure forming machine of asbestos cement tile can't be met the special requirement of the magnesia cement. The straight pressure forming device that is fit for the magnesia cement corrugated tile finally was improved after several facets researching and mending. According to this device, the plane tile can be formed once on the template.

6) The stacking or shelves system: This system mainly is to finish the task putting the straight pressure formed tiles and the tile moulds on the rotary stacker together from the main production line to maintenance line.

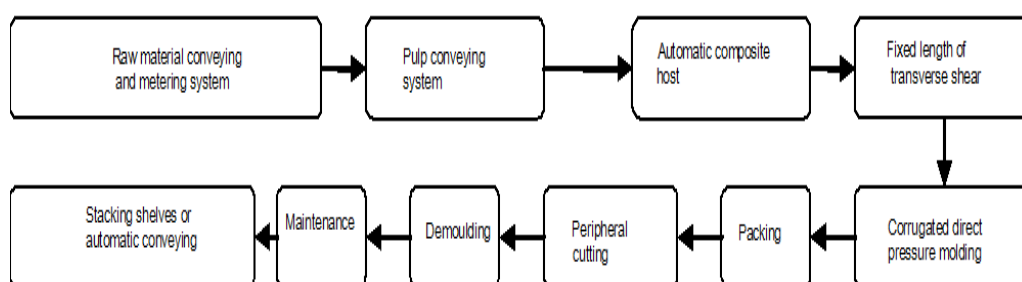


Figure 2: The block diagram of the process for the device

## RESULTS AND DISCUSSION

### The settlement of the key problem

#### The design of the host feeder

Feeder is one of the key components of the device, its design is directly related to whether the two layers of glass grid cloth can leak slurry evenly from hopper and whether any drum belly phenomenon will appear on the rolling roll and the thickness of three layers of magnesia cement is well-proportioned, because of the unreasonable structure of feeding mouth, when we had started, there appeared three phenomena above mentioned in the process of test, after several revisions, the reason was found out and the hopper mouth design is shown as figure 3, it was verified

by many experiments showing that the shape of hopper mouth can completely meet the design requirements and the quality of the tile billet requirements. Later, we put a small amount of short fiber into the original recipe, after testing, we found that the addition of short fibers often caused that short fiber glass blocked up in the hopper mouth, thus this would interrupt the test. In order to overcome the above disadvantages, we tested out the structure as shown in figure 4, which looks like figure 3 in the internal structure and appearance after many modification tests, the difference is that it installs the hinges on the same side of the inside and outside mouth in figure 4. Under normal circumstances, the volume mouth has fixed shape, when it is blocked up, we need only open the hopper mouth that can make jams pass by smoothly, when the work is normal, we only make the hopper mouth rehabilitation without cleaning bicker, the structure shown as in figure 4 has been proved that the structure of the hopper are fully able to meet the requirements of short fiber technology structure after many experiments.

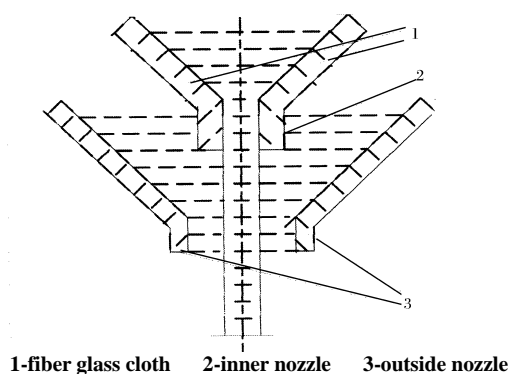


Figure 3: The raw hopper nozzle

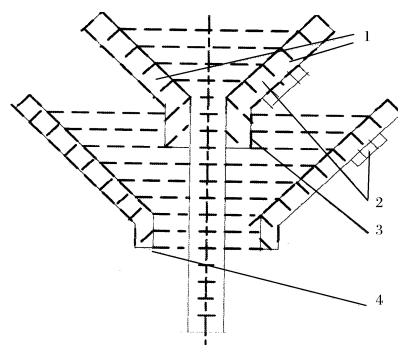


Figure 4: The improved raw hopper nozzle

### The design of the transverse cutting machine

For the tile billet transverse cutting must be finished under the condition of not affecting tile billet continuous movement and the cutting must be thoroughly, at the beginning, considering the material properties and the characteristics of plastic and glass fiber grid cloth, we chose the plan with the high-speed shearing, after using, we found that due to the soft plastic and fiber cloth, clearance between shearing motor and static blade must be adjusted slightly. But this requirement was difficult to be guaranteed in this type of cutting machine, and the blade was worn-out sharply by magnesia cement, therefore we had to give up the plan of cutting. Finally, as the result of exploring in many ways, we decided to adopt high-speed diamond grinding wheel cutter which used diamond wheel tiny edge to grind tile billet. Multiply diamond grinding wheels of cutting machines are installed in the same vehicle used the hydraulic to drive. A guide rail is arranged on the composition of velocity direction. After many experiments, we found the blade of the diamond grinding wheel losing cutting ability for slurry filled edge. After the switching to the metal sheet with a fine toothed blade edge instead of diamond grinding wheel, it overcame the disadvantages of diamond grinding wheel, so the cutting problem had been solved completely.

### The discussion of the main problem and the proposal of the improvement

#### The putting cloth system

For the glass mesh cloth structure is very loose, it will shrink in width direction as soon as it is strained. If the original width is 900 mm, then it might be about 800 mm in the production. This would make the product not enough width. The main reason is that the weft and axis line aren't parallel, especially while the cloth roll of the mesh is changed. So, keeping the weft and axis line parallel, and holding the strain in weft, the shortage could be dealt with.

**The recycling of the plastic film**

The plastic films were cut in the length of 1890 mm during the production line. Then they couldn't be used again, which conducted the cost rising and the market competitiveness subsiding. In order to lower the cost, the question of reusing for the plastic film should be resolved.

**CONCLUSION**

- 1) This production line has been proved that the operation has simple, reliable work, high production efficiency by producing.
- 2) The adaptability for the process is strong, it not only can be used to produce the non staple fiber glass tile, also can it be used to produce the staple. After proper adjusting, the host machine could be applied for producing the suitable thickness magnesia plate.
- 3) This production line can be applied to the medium scale production. But it needs to be further improved. The powder delivery system should be changed into the pipeline and electronic measurement. In order to reduce the bubbles in the slurry, the horizontal mixer used currently should be changed into the vertical and continuous discharging.
- 4) In order to adjust to the mass production requirement, the automatic racking system for tile die should be applied in the stocker.
- 5) The physical properties of the tiles produced by machine which tested had met the part standard requirements in China.

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