PRODUCTION OF WOOD WOOL CEMENT BOARD AND WOOD STRAND CEMENT BOARD (ELTOBOARD) ON ONE PLANT AND APPLICATIONS OF THE PRODUCTS.

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ABSTRACT

At earlier conferences of renowned international organisations such as the FAO, IIBCC and WAEP, extensive information has been published on the properties, production and applications of Wood Wool Cement Board (WWCB), with a density of approximately 400 kg/m³, for industrial applications and Low Cost Housing. See references (1) to (5). At this conference first the production of WWCB on a fully automatic high production plant will be explained and some pictures of the most common applications of WWCB in Western Europe will be shown as well as of a new large WWCB Prefab Element building system in Sweden.

Furthermore information will be provided on a in 1982 completed large complex of Low Cost Houses in Moreda Del Vale near Porto Alegre Brasil, using WWCB, for the walls with concrete frames according to the proven Climatex System.

Thereafter the extra equipment will be explained needed for the combined production of the new Wood Strand Cement Board (EltoBoard), with a density of approximately 1100 kg/m³, on a standard 60 cm WWCB plant making it a WWCB-EltoBoard plant. Also some of the applications of EltoBoard in the Philippines will be illustrated. Finally the production of 120-125 cm (respectively 4') wide WWCB and EltoBoard on a new 120-125 cm (4') WWCB-EltoBoard plant will be explained.

KEYWORDS

Eltomation; Wood Wool Cement Board; Wood Strand Cement Board; EltoBoard; Low Cost Housing.

INTRODUCTION

From the "History of Wood Cement Boards", a summary of an earlier paper at IIBCC, (see reference 5), must be concluded that up till the middle of the 20th century only some basic equipment for the production of WWCB was available. Up till than the dosing of the raw materials, the heavy work and very difficult distribution of the material in the moulds, stripping of the moulds the next day and stacking of the moulds etc., had all to be done by hand by a large number of labourers. Only in the second half of the last century the first automatic dosing and distributing equipment and automatic stacking and handling equipment became available. At the end of the 20th century also a safe and dependable automatic Wood Wool and Wood Strands Shredding Machine became available.

Figure 1

That means only recently all equipment for fully automatic PLC controlled and up to date plants is available. In 1956 the author founded his own engineering company, now Eltomation BV. Since 1956 more than 150 plants for the production of various Mineral Bonded Boards, mostly for the production of WWCB, have been installed in more than 40 countries worldwide. Besides in production technology, Eltomation BV is active in the development of various wood cement products and its applications.

"HISTORY OF WOOD CEMENT BOARDS"

Summary of a lecture presented by Mr. Gerry van Elten of Eltomation in Vancouver, Canada (October 2004). See below.

1900 - The first mineral bonded board was produced by Mr. Schmid(?), a carpenter in Austria using wood shavings and gypsum.

1910 - Magnesium Bonded Wood Wool Boards called Heraklith are produced according to the Austrian patent no. 37223, granted to Mr. Robert Scherer of Vienna in 1908.

1920 - Mr. Josef Oberleitner of nearby Sonntagberg used Portland Cement producing the first Wood Wool Cement Board (WWCB). Several others in Europe followed.

1930 - Mr. Hendrik van der Woerd of Barneveld, Holland produced the first with wooden lath reinforced WWCB roofing boards. Also in Holland the first Cement Bonded Wood Chips (Durisol) boards were produced.

1950 - Mr. Franz Brandsteiner in Maria Rojach, Austria produced the first Velox boards from course wood particles and cement.

1960 - Two German machine manufacturers (Braun and Schneider) developed mixing and dosing equipment and presses. Canali made complete production lines.
In Holland Gerry van Elten obtained an even distribution of the mix in continuous moving moulds at varying speed.

1970 - The first Cement Bonded Particle Board (CBPB) called Duripanel was produced by Mr. Hans Knöpfel of Durisol in Switzerland. The company Bison of Springe, Germany built CBPB plants with air driven distributing machines.

1980 - Gerry van Elten developed CBPB plants using mechanical distributing machines.

1990 - At Amroc in Magdeburg, Germany a new Eltomation mechanical distributing machine for low thickness tolerances was installed. In the Philippines Dr. Pablo developed High Density WWCB with approx. 900 kg/m^3. Knauf Isol in Holland installed the first Eltomatic Wood Wool Machine with 16 knives in a disc.

2000 - Eltomation developed a fully automatic plant for Wood Strand Cement Board with approx. 1100 kg/m^3, called EltoBoard, with 20 N/mm^2 bending strength.

For the full lecture, see reference (5).

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WOOD WOOL CEMENT BOARD PRODUCTION PLANT

Hereunder follows a flow chart, figure 2, and some pictures with descriptions of such a fully automatic plant for the production of WWCB boards.

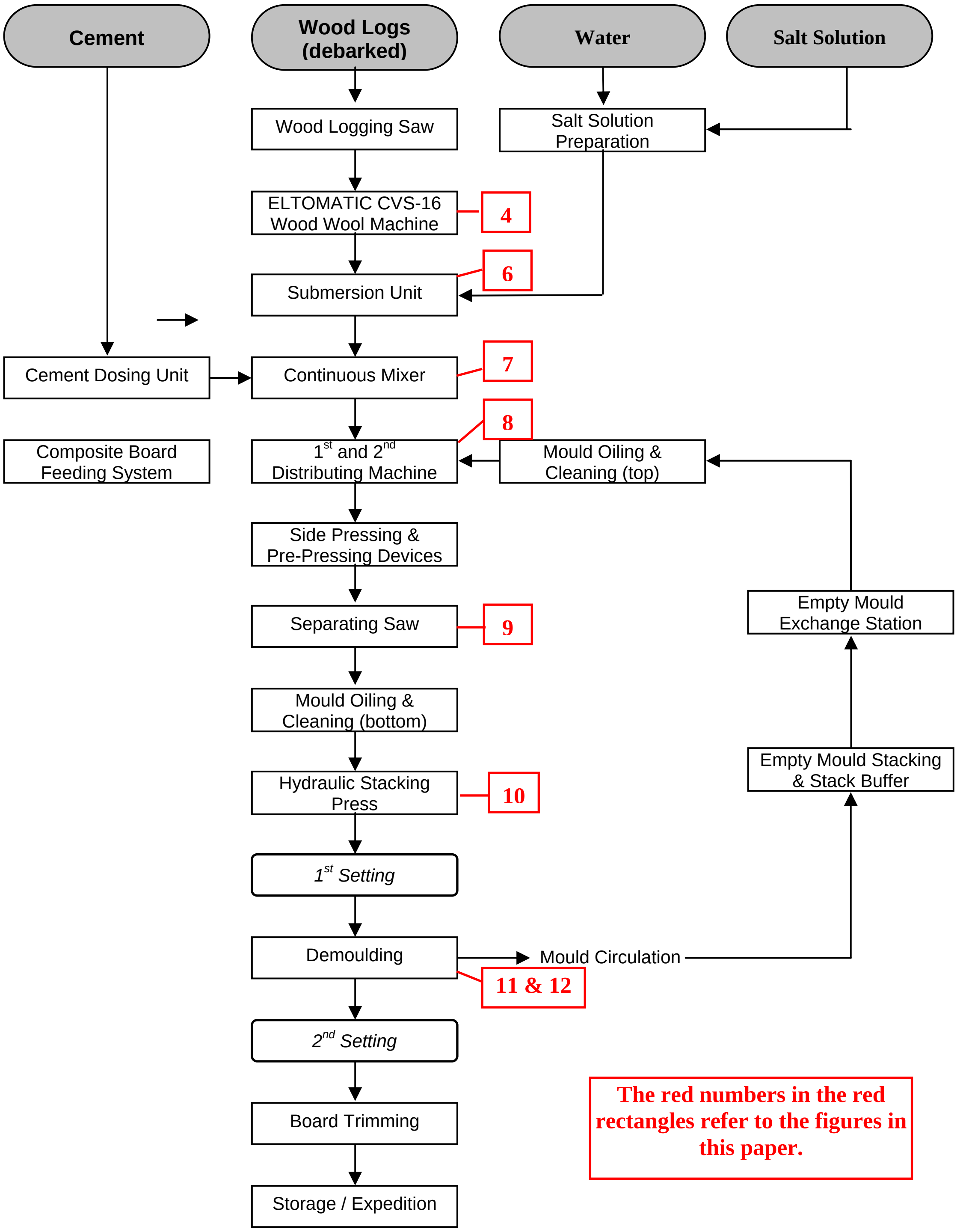

Figure 2

Figure 1 shows a typical fully automatic WWCB production plant. The capacity of such a plant is up to 465 m³ per day, including standardised sandwich boards with cores of different high insulating materials. In Germany WWCB boards are normed with DIN 1101 for thicknesses of 15-100 mm and L x W = 2000 x 500 mm, however also wider boards of 600 mm and longer dimensions of 2400-3000 mm are allowed. In Skandinavia also boards with larger thicknesses of up to 200 mm are produced. Sandwich boards with cores of other high insulating materials are nowadays also normed with DIN 1101. See reference (9).

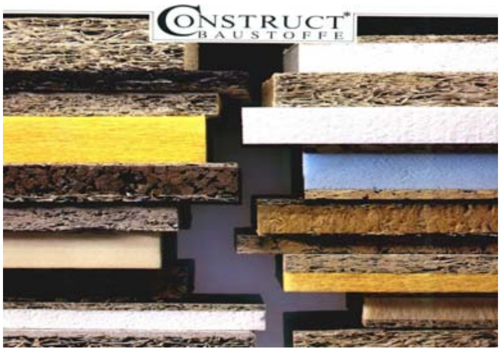

Figure 3

Figure 4

Figure 5

Figure 6

Figure 3 shows a number of standard and special boards. For special products we refer to the internet sites of several WWCB producers in various countries mentioned in reference (6).

Figure 4 shows the fully automatic Eltomatic CVS-16 Wood Wool and Wood Strand Shredding Machine. This machine has 16 knives in a rotating disc and replaces some 10 conventional manual operated Wood Wool Machines with reciprocating sledges with two knives, such as shown in figure 5. Because of the occasional accidents with these conventional wood wool machines, they are now forbidden and new machines are not produced anymore in Western Europe.

Figure 6 shows the continuous submersion unit through which the flow of dry Wood Wool is dipped shortly in a salt solution of low concentration. Some chemicals, in many cases sodium silicate (water glass), are used to stimulate the start of the setting of the cement.

Figure 7

Figure 8

Figure 9

Figure 10

Figure 7 shows the continuous mixer in which the continuous flow of wet wood wool is fed in from behind. The cement coming from the cement silo outside the building is dosed into the mixer by means of a cement dosing unit. The outlet of the mixer is at the left. The irregular flow of wet wood wool is continuously measured by an electronic device for an exactly controlled continuous flow of cement. The relation of wind dry wood wool, water and cement for the fresh mix is approximately 1 : 1 : 2 in weight.

Figure 8 shows a so called double distributing machine to be able to produce also WWCB sandwich boards as normed in Germany with DIN 1104. Sheets of high insulating materials are inserted in the centre of this machine and placed on top of the first layer of fresh WWCB material. Thereafter, for three layer sandwich boards, a second layer of fresh WWCB material is distributed over the core material before they are pressed together.

Figure 9 shows the flying saw in front of the stacking press. This machine cuts the pre-pressed fresh material at exactly the ends of the moving moulds without touching the plywood. This is secured by four to each other connected arms with rolls which snap, all four at the same time, into four openings at the sides of the moulds.

The hydraulic stacking press of figure 10 stacks the moulds with fresh material under pressure form underneath, under the load of the stack plus a weight on top. As soon as the stack is complete the weight on top is held in its top position and the stack of moulds is lowered and moved out of the stacking press. The stacks are taken away by a fork lift truck and placed in the area for the first setting of the cement.

Figure 11

Figure 12

Figure 11 shows the demoulding machine from behind and figure 12 from the side in which picture is shown that the empty moulds move again into the production line.

The following pictures show some of the most common industrial applications of 60 cm wide WWCB in Western Europe:

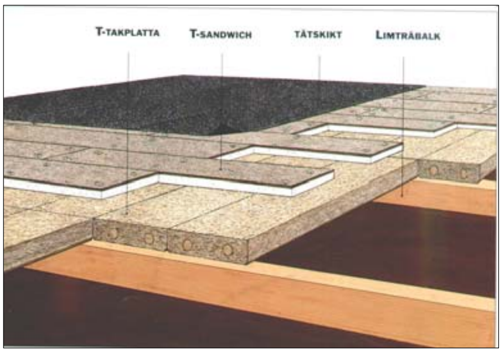

Figure 13

Figure 14

Figure 15

Figure 16

Figure 13 shows relative thick, with two (or three) wooden poles reinforced, long span WWCB roofing boards in Sweden. For extra insulation and waterproofing a layer of composite boards of WWCB and Styrofoam, PU foam or Rockwool as well as roofing felt is placed on top.
In figure 14 white spray painted ceiling boards above a swimming pool in the Netherlands are shown.
Figure 15 shows high rise construction in Austria using hollow prefab Thermoklith WWCB units with dimensions of 30 x 120 cm (1/4 of standard 60x240 cm boards) which are stacked, filled with (reinforced) concrete and later finished with stucco or another cladding. With this system high rise monolitic concrete apartments are built, which are to a high degree resistant to earth quakes. The two WWCB boards assure a high insulation value of the external walls which is special important in mountainous countries, in Northern hemispheres and in countries with continental climates.
Figure 16 shows the insulation of concrete parts of to be stuccoed brick buildings.

NEW WWCB LARGE PREFAB ELEMENTS SYSTEM

Recently a new and very promising application of WWCB has been developed in Sweden. Due to the increased costs for heating and at the same time to enhance the comfort for the inhabitants, the company "Träullit", reference no. (8), started in 2003 experimenting with up to 40 cm thick and monolitic WWCB wall elements, up to 6 meters long and 260 cm high, mainly for residential home building. The WWCB mixture for the production of these elements is taken from the raw material preparation section of the Eltomation WWCB plant.
Due to the high Thermal Insulation Value and the very favourable Thermal Storage Capacity and Humidity Balance (no condensation on the windows in the kitchen and bathroom, not even in the winter), this system seems to be very promising, specially for countries with a cold climate in Northern regions, mountainous areas and in countries with continental climates. In the last mentioned case the high insulating value will also be appreciated in hot summers. See table 1. For a short video movie of their building system and the roofing I refer to the same reference no. (8).

Table 1

Comparison of:	**Thermal Insulation W/m² ºC**	**Thermal Storage Capacities kJ/m² ºC**
Wood framed Mineral Wool	0,14	65
Wood Wool Cement	**0,19**	**250**
Light Weight Concrete	0,28	210
Expanded Clay Blocks (Leca)	0,50	255

All the wall elements are loaded from the truck and installed on the prepared foundation with the help of a crane in one day. Thereafter the large elements are connected to each other by pouring fresh concrete in prepared openings which creates vertical columns at the joints of the elements. Also a reinforced concrete ring beam at the top of the elements will be poured in a prepared groove. After hardening of the concrete, the roof construction and in many cases also the high insulating Träullit wood reinforced long span roofing boards (see figure 13) or Träullit roofing elements will be installed, in this case however in an inclined position. Figure 17 shows a house under construction and figure 18 shows a similar house after being finished with stucco.

Figure 17

Figure 18

In table 2 the number of houses built according to the Träullit system in Sweden on yearly basis are shown:

Table 2

2003: a few experimental houses
2004: 20 houses
2005: 25 houses
2006: 60 houses.
The already booked orders for 2007 do expect a steep increase for 2007 in to be supplied wall elements and roof boards.

CLIMATEX LOW COST HOUSING SYSTEM IN BRAZIL

Dr. Dopheide of Porto Alegre, Brazil who was familiar with the applications of WWCB in Europe, developed the successful Climatex System for Low Cost Housing. During 1980-82 a large project with several hundreds of Climatex houses was created in Moreda dio Vale near Porto Alegre and thousands more in the area. I have inspected this project during the construction in 1980 and again in 2004. I was pleasantly surprised about the condition of the houses after 24 years of occupancy. Most of these houses have in the meantime been extended with extra rooms, and/or been provided with a garage. Due to the use of Portland Cement as a binder and the open structure of WWCB, the material accepts very well fresh concrete and stucco. By careful inspection in 2004 of the interior and exterior walls, I could not find a single crack in any wall nor anywhere in the stucco. Further I noticed the pleasant living condition for the occupants due to the heat insulating walls and ceiling.

Some of the particulars of the Climatex System are:

- Large wall elements of WWCB, connected to each other with fresh concrete beams between the 5 cm thick WWCB, are prepared by hand in the open air on the beforehand prepared foundations. Figure 19 shows such on site prepared wall elements, ready for erection and figure 20 shows the erection of the light weight wall elements.
- The fresh concrete for the columns between the boards and the frames all around the large elements get some steel rods as reinforcement. Some other steel wires extending from the frames are later used for connecting the erected elements together after which the elements get the first layer of stucco.
- No crane or heavy machinery is required.
- The insulating WWCB walls and ceilings are very durable and assure a pleasant living condition with a high degree of comfort for the occupants.

Figure 19

Figure 20

Figure 21

Figure 22

Figure 21 shows a house ready for receiving the final white surface stucco and figure 22 shows an aerial view in 1982.

Figure 23

Figure 24

Figures 23 and 24 show two of the several pictures of houses and WWCB ceilings taken on my request by Mr. Luiz Bueno of the Netherlands Business Support Office in Porto Alegre in 2002.

PRODUCTION OF ELTOBOARD ON A WWCB – ELTOBOARD PLANT

After learning of the successful applications of High Density Wood Wool Cement Boards (HD-WWCB) of approximately 900 kg/m³ developed by Dr. Arturo A. Pablo, the former head of the Wood and Forestry Research Center in Laguna, the Philippines in the 1990's, Eltomation has optimised and patented in various countries the production process using automatic and some special extra equipment. Also the product itself was improved and patented in respect of using wider and thinner strands, and a higher density of approximately 1100 kg/m³. For the production of EltoBoard moulds of plywood and all the equipment as needed for the production of WWCB can be used. The pressure needed for pressing EltoBoard with a density of 1100 kg/m³ is still within the range of the resistance of high quality plywood and in view of the at that density obtained properties, as strength and screwholding forces, in most cases no higher density will be required. Therefore an existing WWCB plant for the production of 60 cm wide boards was renovated and provided with an extra EltoBoard Bundle Press, see figure 27, to produce also EltoBoard on that plant. See also the flow chart of the production of EltoBoard, figure 33.

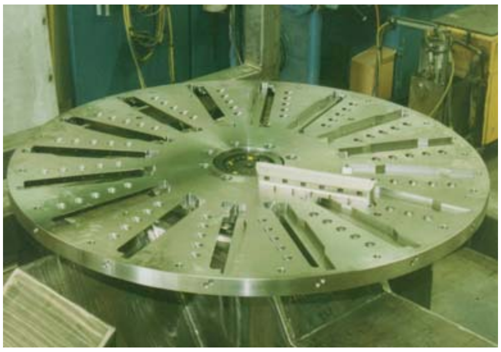

Figure 25

Figure 26

Figure 25 shows the disc for 16 knives in cassettes for shredding the wood strands. On top of it a cassette for one of the knives is shown. Figure 26 shows the for EltoBoard favourable thin and wide strands (e.g. 0,25 mm x 8 mm) which are shredded with the same Eltomatic CVS-16 as used for the production of WWCB. For cutting wider strands other knives are needed. For the production of Wood Strands and test results of EltoBoard, I refer to reference (7).
EltoBoard (1100 kg/m³) is close to three times as dense as WWCB (400 kg/m³) but needs between the rims somewhat wider moulds for deeper trimming of the sides of the boards. Therefore the amount of raw materials needed for the production of 1 m³ EltoBoard netto should be taken approximately 3x of that needed for 1 m³ WWCB.

Flow chart of the production of Wood Strand Cement Board (EltoBoard) on a EltoBoard / WWCB production plant

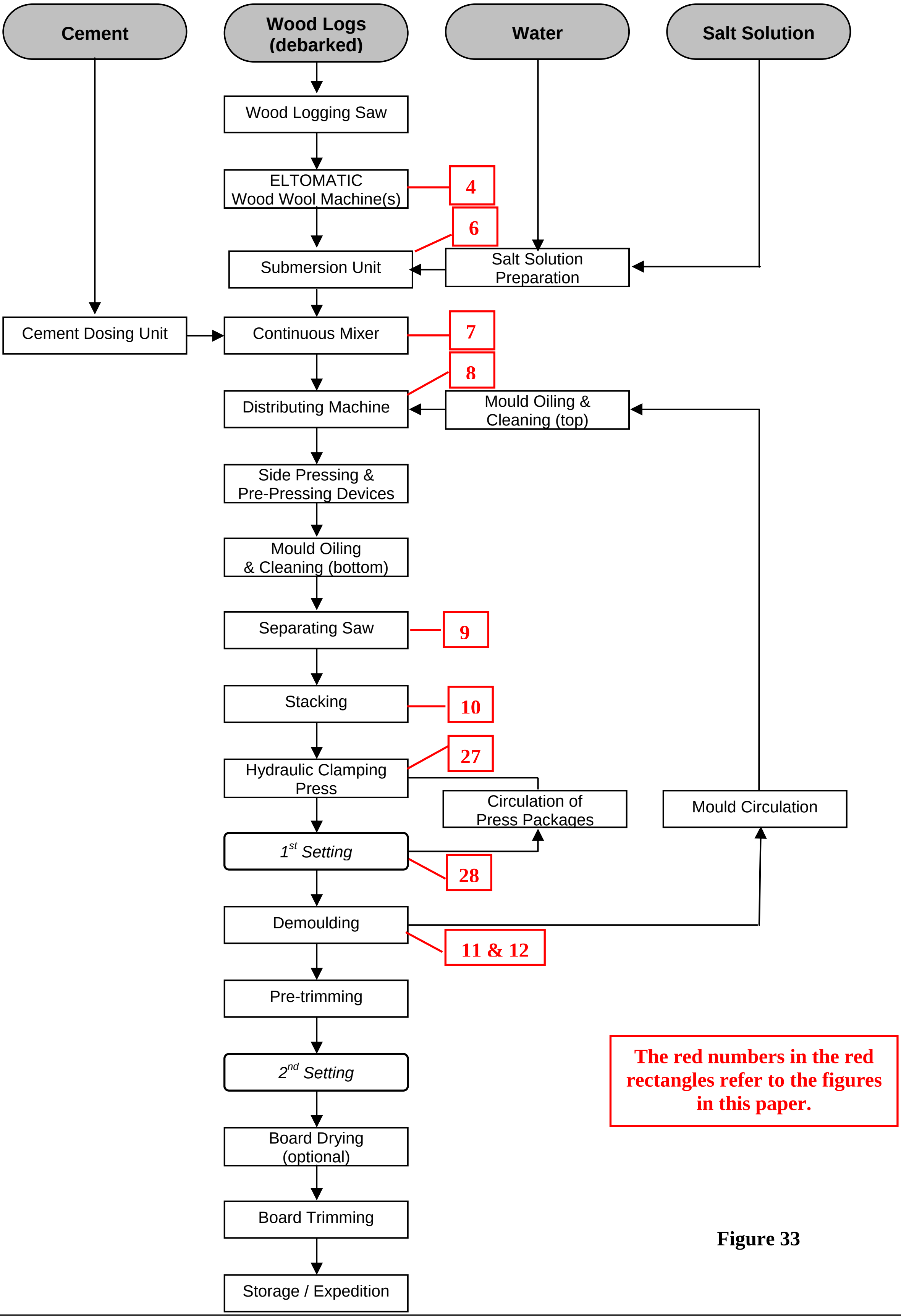

Figure 33

Figure 27

Figure 28

During setting of the cement the fresh EltoBoard is kept under pressure by means of Press Packages, figure 28. Such a plant has been in production at a small plant in Bosnia for some years now, however will probably in the near future be moved to Latvia, close to the market in Russia. In case for some reason one would want a considerable higher density than 1100 kg/m3 one may have to use cauls of steel. However than also most other equipment of the plant will have to be of a heavier construction. In that case it would be better to combine the production of Eltoboard with that of CBPB. For this we refer to the paper of Ing. E.J. (Bert) van Elten, at this conference, reference no. (7).

APPLICATIONS OF ELTOBOARD IN THE PHILLIPINES

Figure 29

Figure 30

Figure 31

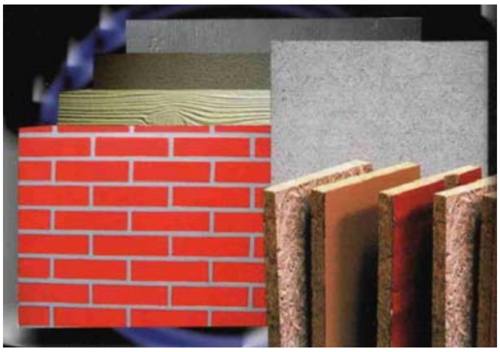

Figure 32

In figure 29 a complex of wood framed social houses, cladded at the interior and exterior with painted, non painted natural and stuccoed HD-WWCB is shown. Figure 30 shows a non painted floor from underneath and cladding of a beam. Further at the interior side of the wall painted HD-WWCB.
Figure 31 shows at the exterior painted boards and planks.
Figure 32 shows Eltoboard from Bosnia with various embossed and painted surfaces.

PRODUCTION OF 2' WWCB AND 4' ELTOBOARD ON A 4' WWCB-ELTOBOARD PLANT

For a customer in Malaysia, who wants to produce 4' wide EltoBoard and 2' wide WWCB, both products will be produced on a 4' WWCB-EltoBoard plant, now under construction. Due to the low and moderate pressure needed, moulds of plywood can be used. After curing, the WWCB will be cut in two boards of 2' width.
Note: For the production of 120-125 cm and/or 4' wide EltoBoard in combination with the production of 120-125 cm (4') wide high density Cement Bonded Particle Board (CBPB) of 1250-1400 kg/m3, cauls of steel are needed. For a description of the production of EltoBoard and CBPB on such a combined CBPB – EltoBoard plant and applications of these boards, I refer to the paper of Ing. E.J. (Bert) van Elten at this conference, reference (7) and to the website of Eltomation, see reference (6). This website also shows a list of various companies with new, or in the past 10 years by Eltomation renovated, plants. Also for a comparison of the properties of EltoBoard with CBPB I refer to reference (7). The websites of producers show extensive information on properties and applications of standard and special wood cement products. For the addresses of these websites, please see reference (6). For the test results of EltoBoard obtained from the Moscow State Forestry University and others, we refer to reference (7).

CONCLUSION

By combining the production of the new Wood Strand Cement Board (EltoBoard) with the production of WWCB on a new or existing WWCB plant, the producer will be able to manufacture and sell two quite different products, hereby increasing his market. This can be realised with low extra investment.

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