

NEW DEVELOPED ELTOMATION PLANT CAPABLE TO PRODUCE ALL TYPES OF: - WOOD WOOL CEMENT BOARD (WWCB); - WOOD STRAND CEMENT BOARD (WSCB - ELTOBOARD); AND – LARGE WWCB WALL ELEMENTS.

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ABSTRACT

This paper reports the further development of advanced production technologies for the manufacture of various types of wood cement boards. Due to the increased demand for comfortable living conditions with increased energy savings, the demand for various types of wood cement boards have increased significantly over the recent years. With this increased demand for energy-saving boards, the demand for automated production lines has also increased.

Eltomation BV is currently developing and supplying several new plant types which allow the production of Wood Wool Cement Boards (WWCB), Wood Strand Cement Boards (WSCB – EltoBoard) and the newly developed Large WWCB Wall Element. All 3 product types can be produced on one combined production plant, where the client requires full flexibility in production, optimized utilisation of floor space, reduced capital investment, reduced labour requirements for operation and environmentally clean production.

KEYWORDS

Eltomation; Wood Cement Products, Wood Wool Cement Board (WWCB); Wood Strand Cement Board (WSCB - EltoBoard), Large WWCB Wall Elements; WWCB Production Technology.

INTRODUCTION

Eltomation BV of Barneveld, The Netherlands, is specialized in the development and supply of turn-key plants and equipment for the production of various Wood Cement Boards. The main products produced on these plants include: - Wood Wool Cement Board (WWCB); - Wood Strand Cement Boards (WSCB - EltoBoard) and - Large WWCB Wall Elements. Through the years, the majority of our plants have been supplied to clients in (Western) Europe and include plants to renowned producers such as Knauf Insulation (incl. formerly Heraklith) with multiple plants in France, Germany, Austria, The Netherlands, etc., Further to other major producers, such as: Fibrolith – Germany, Celenit – Italy, Hammerich – Denmark, Träullit – Sweden and others. During the last few years a highly increased interest for durable, environmental friendly and energy-saving building materials has come from the greater Russian market. In view of the high demand for various wood-cement boards, Eltomation has obtained orders for large wood-cement board plants, where the clients demand flexible production of multiple product types at a high output of up to 1.000 m³ of finished product per day. This range of products will either be marketed and used as general building material or be used as intermediate product for pre-fab housing, in which case the output of the plant will be complete pre-fab houses. The demand for these combined plants required innovative and new technologies to be developed by Eltomation.

History of wood cement boards

In previous papers submitted to IIBCC (IIBCC 2004, Vancouver, Canada and IIBCC 2006, Sao Paulo, Brazil), the founder of Eltomation, Mr. Ing. Gerry van Elten provided a detailed overview of the history of wood-cement boards. This overview dates back from the first production of Magnesium and Cement Bonded Boards in Austria as early as 1910 / 1920. Van Elten / Eltomation BV started the development of the first Forming Stations for Wood Wool Cement Board by the late fifties and has since then further developed its production lines into fully-automated production lines for the production of consistent high-quality boards at high production capacities. During the initial production of wood wool over the first 70 years, only manually operated reciprocating (sledge) wood wool machines were utilised. These hand-operated machines were however dangerous to operate, required exact lining of the knives and sledges and heavy concrete foundations. It took until the nineties when also the last phase of the wood wool cement board production was fully automated, being the fully-automated production of wood wool / wood strands. At that time Eltomation finalised its development of the Rotating Eltomatic CVS-16 with 16 knives in a rotating disc. By now, virtually all WWCB Plants in Western Europe have replaced the old reciprocating wood wool machines with the Eltomatic CVS-16, providing high-quality (chip-free) wood wool at a high capacity. Furthermore, with this new machine, remaining waste pieces are virtually eliminated.

Another recent development by Eltomation is the so-called Wood Strand Cement Board (WSCB) or EltoBoard. This board is made out of long, thin and relative wide wood strands and pressed to a density of approx. 1100 kg/m³ (in comparison WWCB has a density of only approx. 400 kg/m³). The "interlocking" of the long wood strands provides a high bending strength (approx. 20 MPa), better flexibility, a high screw-pulling-force and lower swelling and shrinking characteristics in length, when these figures are compared to the known Cement Bonded Particle Board (CBPB). A detailed overview of the properties of WSCB / EltoBoard can be found in the paper of Mr. Gerry van Elten as presented at the IIBCC 2006 conference in Sao Paulo.

In total, Eltomation has during the last decades, realised over 170 wood-cement board projects in more than 40 countries worldwide, with the majority of its projects in (Western) Europe. During recent years the excellent insulating and acoustic properties of Wood Wool Cement Boards have also attracted an increased interest from architects, builders and board producers in countries such as China and former Soviet States (Russia, Ukraine, Kazakhstan, etc.). Due to extreme climatic conditions which are found in those areas, specially the need for thermal insulation increased, to meet the demands for more comfortable living conditions.

As a first of several new projects in Russia and (Northern) Europe, Eltomation will therefore supply a so-called Large WWCB Element Line. This Large WWCB Element has recently been developed by one of Eltomation's clients, Träullit in Sweden. These Large WWCB Elements comprise of solid WWCB with dimensions of up to 6 meters (20') in length, 3 meters (10') in wall height and up to 40 -50 cm (1' - 4" to 1' - 8") thickness, subject to the local climatic conditions. The low density of approx. 300 kg/m³ provides a high thermal insulation value (0,19 W/m² °C) at low cost. Furthermore these Elements provide a high Thermal Storage Capacity (250 kJ/m² °C).

During the first years of production of the Large WWCB Wall Elements, Träullit has optimised its production using semi-automated production facilities, such as for forming, demoulding, storage, cutting/finishing, etc. In close cooperation with Träullit, Eltomation has now recently completed the development of a production line for the fully-automated production of such Large Wall Elements, at high capacity and reduced labour requirements. Träullit expects to implement such fully-automated line in the very near future, which will enable it to cope with the increased demand for its high energy-efficient housing system.

Production flowchart (simplified)

The figure below (Figure 1) provides a simplified flowchart for a typical WWCB Plant. In reality, several of the steps shown consist of multiple steps with special equipment. However for this presentation a simplified flowchart will be sufficient.

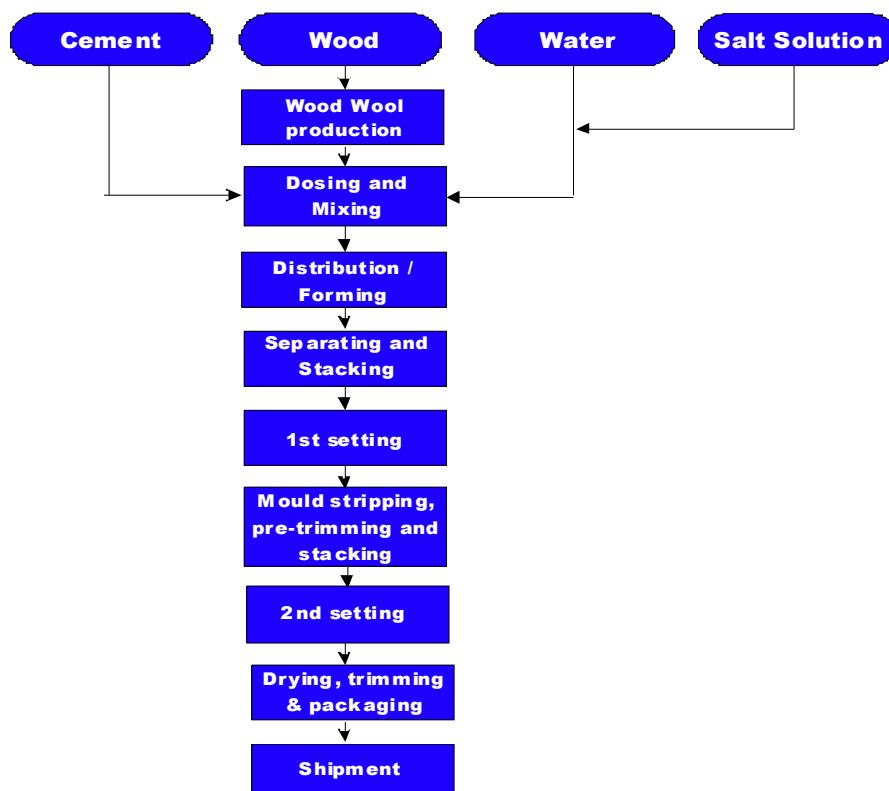


Figure 1 – WWCB Production Flowchart (simplified)

Overview of main wood cement products

In general the following Wood Cement Boards are considered to be the main products which are on the market today:

1. Wood Wool Cement Board (WWCB);
2. Wood Strand Cement Board (WSCB/ EltoBoard);
3. Large-size WWCB Elements (as developed by Träullit, Sweden);
4. Wood Residue Cement Board (WRCB);
5. Cement Bonded Particle Board (CBPB).

This paper will mainly deal with the production technology for first three mentioned product types. Each of these 3 product types require as raw material small diameter logs (mostly soft wood species such as Pine, Poplar, Eucalyptus, etc.) to enable the production of long thin wood wool or wood strands.

For projects, where there is not sufficient round wood available, an alternative to WWCB/WSCB is a so-called Wood Residue Cement Board (WRCB) with a density of approx. 800 kg/m³. For these type of plants usually residue wood, such as slabs from saw mills is used. In some cases also round wood is chipped into medium size wood particles/flakes. When so required, with a different wood preparation system and some alterations in the forming system a standard Eltomation WWCB/WSCB Plant can optionally be set up as a WRCB Plant.

The 5th listed product, Cement Bonded Particle Board (CBPB) requires a complete different plant set-up and typically produces boards of 1,2 m (4') width. Using small wood particles as a basis, these boards need to be very high pressed (density up to 1250 – 1400 kg/m³) to provide sufficient strength. This board will not be described in this paper. For a full description on the production process reference is made to the paper of the author at IIBCC 2006, Sao Paulo.

Properties of wood wool cement board

Of the previously described main Wood Cement Products, Wood Wool Cement Board (WWCB) is by far the most common product with a large number of plants in operation. To ensure its excellent properties in view of thermal insulation and sound absorption, WWCB is produced at a low density of only approx. 400 kg/m³. The main features of WWCB are:

- Thermal insulation
- Wet and dry rot resistance
- Fire resistance
- Termite resistance
- Sound absorption
- Light weight and easy to handle
- Excellent base for stucco and plaster

For increased thermal insulation, WWCB is also often produced as a (2 or) 3 layer sandwich board with a core of EPS/Polystyrene, Rockwool or PU-foam.

Production line for WWCB

The (summarized) video shown during the presentation will show a typical Eltomation WWCB production line in full operation. Boards are typically 60/61 cm (2') wide and 240 – 300 cm (approx. 8' - 10') long. Thicknesses range from 15 to 150 mm. The capacity of a standard Phase IV Plant is up to 465 m³ per day with production speeds of the main line of up to 20 m/min. (in average one board per 7 seconds). Nowadays WWCB is produced in accordance with EN 13168 (formerly DIN 1101). Besides upgrading of such plants at the existing customer base in Europe, new similar turnkey Phase IV plants have recently been supplied to South Korea, China (2) and currently also Russia.

Wood strand cement board (WsCB – eltoboard)

The production of medium-density Wood Strand Cement Board (WSCB – EltoBoard) is accomplished on a WWCB Plant to which a special EltoBoard Press has been added, which will compress the fresh wood-cement mat to a much higher density. The result is a Medium Density Board with Structural Strength (up to approx. 20 MPa). Board dimensions are typically 60 cm wide and 240-300 cm long. Board thicknesses range from 8-25 mm. Eltomation is currently also developing a production line to produce WSCB - EltoBoard as 120 cm (4') wide boards, which will allow the client to cover a broader market-range. E.g. for replacing other structural boards such as CBPB and OSB, for reasons of moisture-, fire- or insect resistance. For a detailed description of the production process of WSCB, reference is made to the IIBCC 2006 (Sao Paulo) paper of Mr. G.J. (Gerry) van Elten. This Publication is available on the website of Eltomation (www.eltomation.com) under "Publications".

Large wwcb wall element building system

During the last few years, a new revolutionary large-size wall system has been developed by one of Eltomation's clients, the company Träullit in Sweden. These Large Wall Elements are made out of solid WWCB with dimensions of up to 6 m (20') in length, 3 m (10') in wall height and up to 40 -50 cm (1' - 4" to 1' - 8") thickness, subject to the local climatic conditions. In addition to the high thermal insulation (0,19 W/m² °C), these Elements provide a high Thermal Storage Capacity (250 kJ/m² °C).

During the first years of production of the Large WWCB Wall Elements, Träullit has further optimised its product using semi-automated production facilities, such as for forming, demoulding, storage, cutting/finishing, etc. In close cooperation with Träullit, Eltomation has now recently developed a production line for the fully-automated production of such Large Elements at high capacity and reduced labour requirements. Träullit expects to implement such fully-automated line in the next few years, which will enable it to cope with the increasing demand for its high-energy efficient housing.

The following pictures (Figures 2-9) illustrate such Elements after production, during storage, transport and installation, followed by 2 pictures of a ready houses, as installed in Sweden.



Figure 2 - Full moulds after forming.



Figure 3 - Opening of mould.



Figure 4 - Demoulding (semi-automatic).



Figure 5 - Curing area for Elements.



Figure 6 - Arrival of Elements at building site



Figure 7 - Installation of Large WWCB Elements



Figure 8 - Villa (still without stucco)



Figure 9 - Ready house with high comfort

New developed production line for Large wwcB wall elements (step 1)

As a first step of this new development, Eltomation is currently building a new production line for the fully-automated production of Large Wall Elements. Dimensions for these Large Elements will be: 6 m (approx. 20') length x 3 meters (approx. 10') height. The wall thickness will be based on minimum 30 cm (approx.

1') and maximum 60 cm (approx. 2'), which will allow the client to optimise the final wall thickness subject to his climatic conditions. Note: Initial calculations have shown that for the extreme cold climate in Siberia, Russia (temperature in winter at minus 40 °C, being minus 40 °F), a wall thickness of 35 cm will be sufficient. However, due to specific wishes of the client for special applications, it was decided to determine the range for the wall thickness from 30-60 cm. The capacity of the Large Wall Element Line was determined to be approx. 500 m³ of finished product per day (based on a 3 shift production). This capacity is based on a standard production capacity of wood wool with one Eltomatic CVS-16 wood wool machine and the use of a standard Dosing and Mixing department (similar equipment as currently used in the Phase IV 60 cm WWCB Plant). Based on an average wall thickness of 40 cm, the plant capacity is therefore approx. 1.250 m² of ready Large Wall Elements per day.

During engineering and discussions with the clients it was decided to engineer and build 2 versions of the Large Element Filling Line, Versions A and B. Version A consists of a standard Eltomatic wood wool machine, a standard Dosing and Mixing Line and a simplified Single Forming Station for filling individual moulds one at a time. The Mixture is directly dosed into the individual large Moulds, which pass underneath the Forming Station. Full moulds are taken away by fork lift truck to the First Setting Area for initial curing. To have sufficient pressure on the filled moulds during curing, filled moulds are stacked up to 5 high in the Curing Area. For Demoulding, the cured Element is lifted out of the Mould by means of an overhead crane system. Due to this semi-automated operation and the concept of filling one Mould at a time, the capacity of this simplified version is limited.

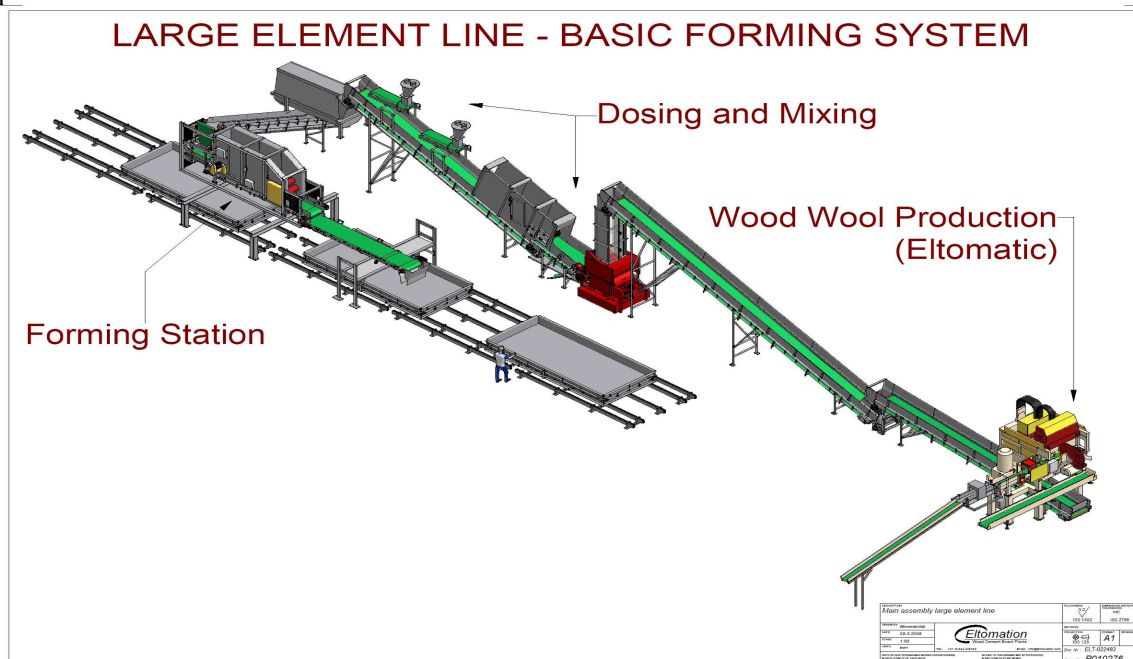


Figure 10 – Version A: Large Element Line, Basic Forming Station for individual moulds

To take away the limitations of the Simplified Version A, in view of production capacity, Eltomation has also developed a forming system which will distribute the wood-cement mixture, out of a second (main) Forming Station, over the full width of the board (in this case 3 m (10') width), into continuously moving moulds as one long mat. The long (continuous) mat is separated at the next station by means of a so-called flying saw. Individual full moulds are thereafter placed into a First Setting Area for initial curing during approx. 24 hours. After curing, full moulds are automatically “stripped” / “demoulded” by means of a Demoulding Station to release the cured Elements from the Mould. Each Element is thereafter transferred to a 90 ° Lifting Unit, which will place the ready Elements in an upright position. Ready Elements are thereafter taken to storage by means of the overhead crane system for further curing. Empty Moulds are cleaned and oiled and automatically returned to the Forming Station to again be filled with WWC mixture.

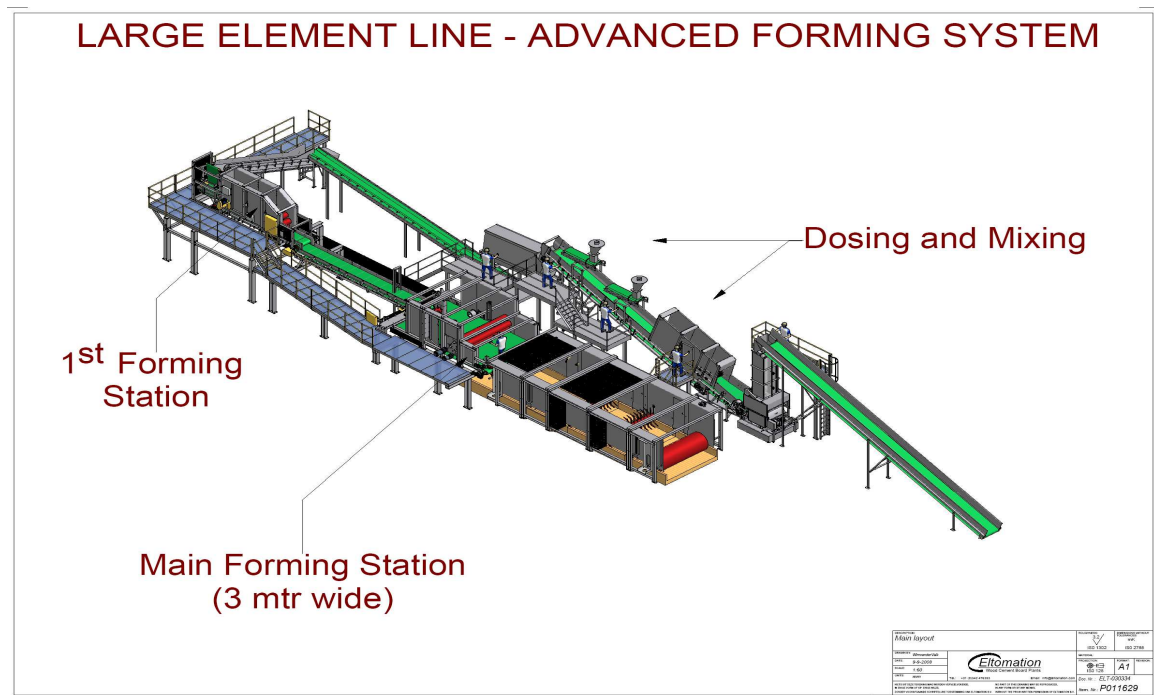


Figure 11 – Version b: Large element line, advanced forming system

New developed production line for Large wwcB wall elements in combination with a Standard 60 cm wcb/eltoBoard plant (step 2)

To enable a client to produce the full range of WWCB products, being WWCB, WSCB-EltoBoard and Large Elements (LE), as a next step it was required to design a plant concept which would meet the following starting points:

- Total product mix of WWCB, WSCB and LE, which serves as basis for a complete pre-fab housing line;
- Capacity: 600 - 900 m³ per day of finished products;
- Both lines run independent from each other, although the wood-cement mixture can be shared;
- Combined system for wood handling, cement supply, raw material mixing, dust extraction, etc.;
- Resulting in: Reduced requirements for labour and optimised utilisation of equipment and floor space.

The following pictures show our concept for such Combined Plant, where we combine a Phase IV WWCB - EltoBoard Plant (with a capacity of 12.000 m² per day or up to 465 m³/day of WWCB) with a full-size Large Element Line (with a capacity of up to 500 m³ per day). Figure 12 shows the overall plant layout in a building of 180 m (approx. 600') length and 2 sections of each 30 m (100') width. The clear height in the building is approx. 7 m (23'). This includes floor space for indoor storage of wood logs in winter, storage of intermediate products (first and 2nd setting) and final product storage.

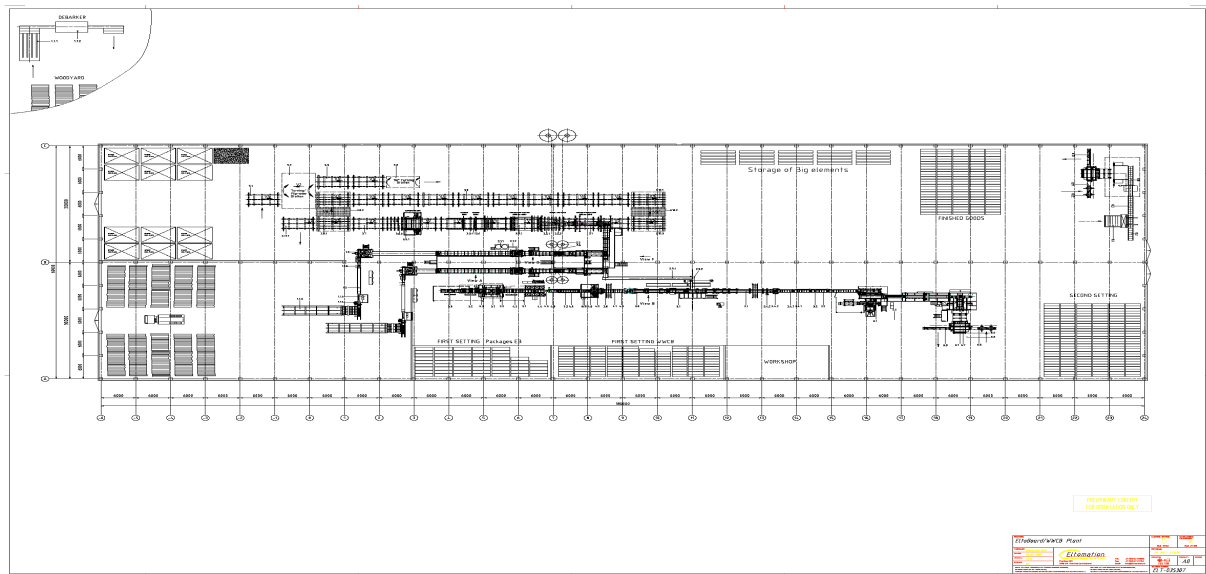


Figure 12 –Plant layout for a combined WWCB-EB Plant and Large Wall Element Line.

Figure 13 shows the WWCB/EltoBoard Plant section in green, while Figure 14 shows the Large Element Line section in blue.

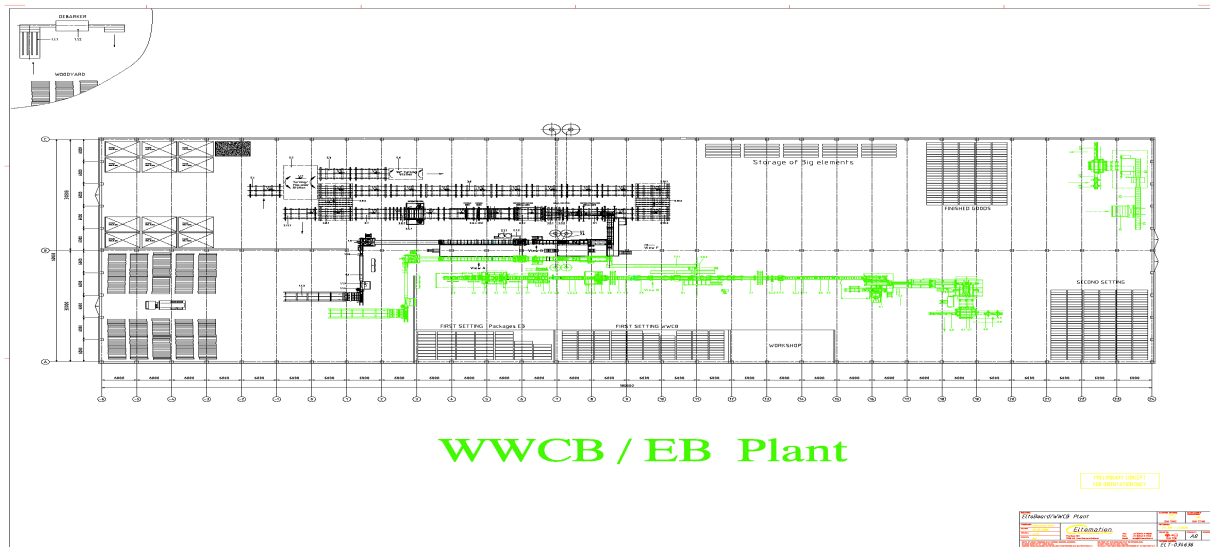


Figure 13 – WWCB/EB Plant further detailed (in green)

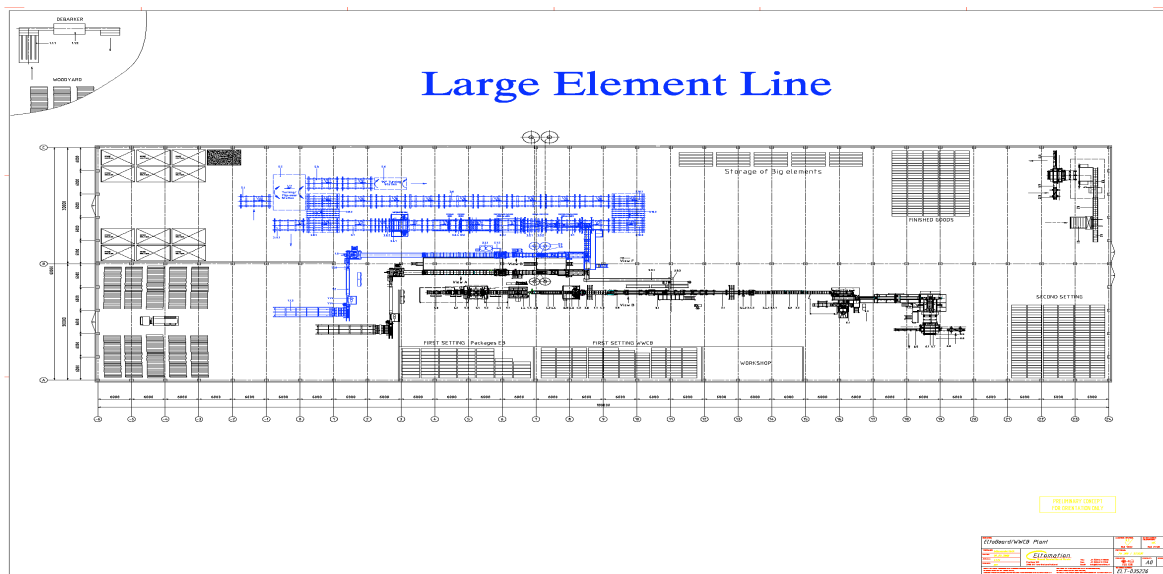


Figure 14 – Large Wall Element Line further detailed (in blue)

The main sections of this layout are shown in the next picture where we more clearly show:

- a) the combined storage of wood logs and infeed of wood wool to both lines (red area),
- b) the combined storage and supply of cement to both lines (green) and
- c) the combined dust extraction system (blue).

Furthermore, the combined mixing area requires only one supervisor to oversee both mixing lines.

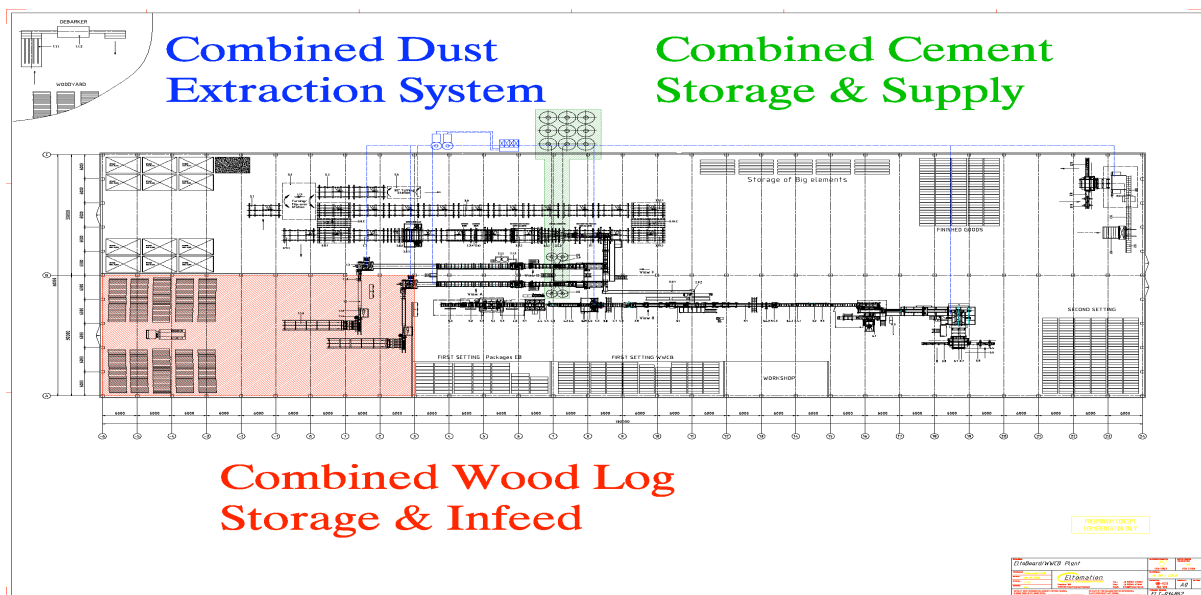


Figure 15 – Combined areas for Wood Infeed, Cement Supply and Dust Extraction

Another feature we built-in into this plant concept is the ability to use the fresh mixture from one wood wool / wood strand preparation and mixing group to be diverted to the other line (as shown in Figure 16). This feature may also be required in view of possible down-time or maintenance in one of the wood strand preparation or mixing groups.

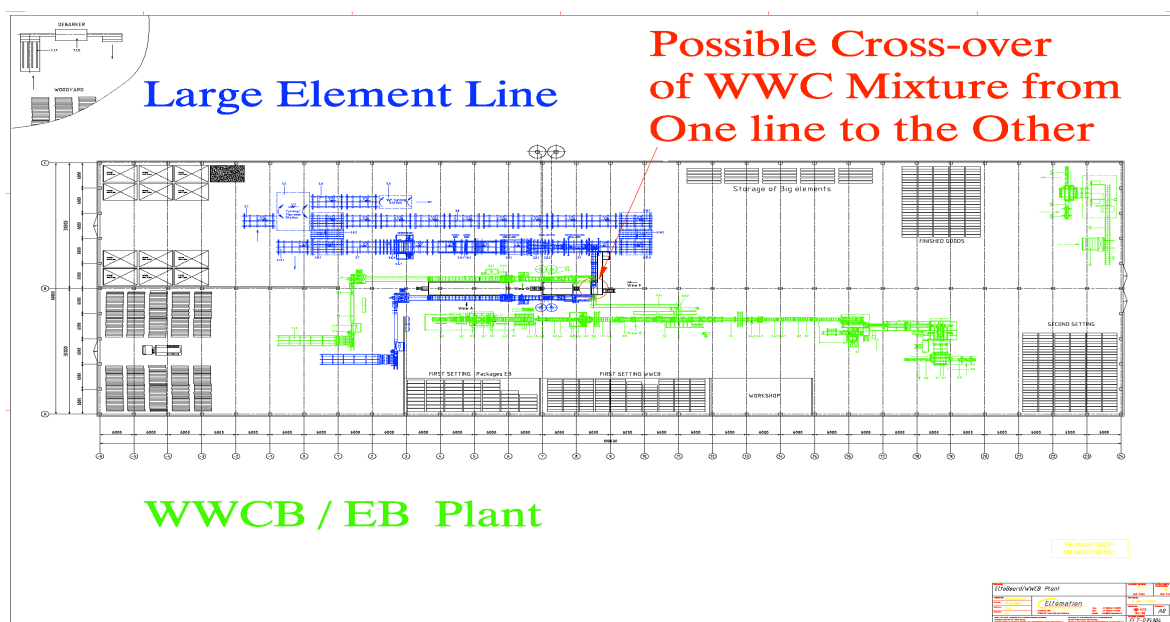


Figure 16 – Cross-over possibility for wood-cement mixture

SUMMARY (CONCLUSION)

In summary one can say that in recent years, worldwide there has been a strongly increased demand to construct houses with considerable increased energy savings, combined with a high standard of comfort. In addition home-owners require a durable product, which include properties such as fire-resistance (note the recent forest fires and subsequent sharp increased premium for fire insurance in e.g. the USA), resistance against termites, fungi, etc. This has resulted in a world-wide increased demand for products such as Wood Wool Cement Board. This demand resulted in the development of the Large WWC Wall System. Recent official fire tests have shown a fire-resistance of these Large WWC Wall Elements of 6 hours. In view of the excellent properties of WWC and the very efficient building system using these Large WWC Wall Elements, Eltomation expects a further demand for the combined plant concept. Such first fully automated lines will become operational in the spring/summer of 2009 and may set a new standard for large-scale, durable and affordable, economic housing. Eltomation will continue its engineering and design activities to meet the demands of its client now and in the future.

ACKNOWLEDGEMENTS

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(Note: These Publications can also be found on the website of Eltomation under "Publications").