A COMPOSITE BOARD AND A METHOD OF MAKING THE SAME

FIELD OF THE INVENTION

The invention relates to a composite board and a method of making the same. The invention is particularly suitable for use as boards requiring a high strength to weight ratio such as, but not limited to a shuttering board.

BACKGROUND TO THE INVENTION

The following discussion of the background to the invention is intended to facilitate an understanding of the present invention. However, it should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was published, known or part of the common general knowledge in any jurisdiction as at the priority date of the application.

Shuttering boards are commonly used at construction sites to maintain poured concrete in a desired shape. It is particularly used in maintaining poured concrete that, when set, forms a vertical pylon or the like. This process of maintaining the poured concrete in predefined shapes is also known as formwork.

There are essentially three types of shuttering boards that can be used:

Plywood shuttering boards. Such shuttering boards are cheap. But subject to degradation with each use. As a result, plywood shuttering boards are often re-used somewhere between 8 to 10 times before they need to be changed. Changing such shuttering boards consumes additional labour and material costs. Furthermore, the used plywood shuttering boards must be disposed of in some manner, often by incineration, which creates further environmental problems.

Steel shuttering boards. Being made of a more durable material, steel shuttering boards may be re-used up to 100 times before needing to be changed. However, this durability is also a disadvantage as such shuttering boards are difficult to handle and shape at the construction site.

Plastic shuttering boards. Plastic shuttering boards have been introduced to the market with limited success. The main reasons for this lack of success has been their low strength to weight ratio. While some attempts to improve the strength to

weight ratio of plastic shuttering boards have been technically successful, it has been done at such a high production cost that the commercial viability of such boards has been significantly compromised.

It is therefore an object of the present invention to produce a composite board which has significant durability that can be recycled.

SUMMARY OF THE INVENTION

Throughout this document, unless otherwise indicated to the contrary, the terms "comprising", "consisting of", and the like, are to be construed as non-exhaustive, or in other words, as meaning "including, but not limited to".

In accordance with a first aspect of the invention there is a composite board comprising five layers of material, the first layer of material consisting of one material from a first hard plastic material set, the second layer consisting of a metal having at least a substantially high strength to weight ratio, a third layer of material consisting of a wood material, a fourth layer consisting of a metal having at least a substantially high strength to weight ratio, a fifth layer of material consisting of one material from a first hard plastic material set, where the layers are bonded in a sequential fashion and the resulting board being laminated.

Ideally, the material used in the first layer is also used in the fifth layer. In its most preferred embodiment, the composite board is further constructed in a manner that the material used in the second layer is also used in the fourth layer. This allows ease of manufacturing as the number of materials needed for manufacturing will be significantly reduced.

The first hard plastic material set, preferably, includes polyethylene, polyvinyl chloride or polypropylene. The core layer is preferably either a wooden board or plywood.

The intermediate second and fourth layers are ideally made up of aluminium sheeting. This provides the necessary strength to weight ratio, while at the same time having good durability properties.

For most building sites it is preferred that the composite board have a thickness between 9 and 50mm with the ideal thickness of the composite board being

between 10 and 18mm. Composite boards of a smaller thickness do not have the strength for general usage on a construction site. Composite boards of greater thickness have limited durability (and may require additional strengthening structures), which further limits the advantages of the current invention, not to mention the attendant manufacturing difficulties.

Boards in the range 10 to 18mm provide the best overall performance and are relatively easy to manufacture compared to boards of other sizes.

The proportions between the differing layers may vary, but ideally the size of the first and fifth layers do not exceed 2mm in thickness. It is also preferred that the thickness of the third layer, as a proportion of the total thickness of the composite board, remains at substantially 80%. The size of the second and fourth layers can vary depending on the overall strength desired for the composite board.

Thermal bonding may be used to sequentially bind each layer to its next layer. Each layer is sequentially bound to its next layer by adhesives. The adhesives are applied evenly on each layer. It is further preferred that any such bond be waterproof. The whole composite board is then applied under heavy loads for a certain duration until the adhesives are set

In accordance with a second aspect of the present invention there is a method of producing a composite board comprising the steps of:

bonding a first layer made of a material from a first hard plastic material set to a second layer made of a metal having at least a substantially high strength to weight ratio;

bonding the second layer to a third layer made of a wood material;

bonding the third layer to a fourth layer made of a metal having at least a substantially high strength to weight ratio; and

bonding the fourth layer to a fifth layer made of a material from a first hard plastic material set; and

laminating the bonded board.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is an exploded view of a composite board according to a first aspect of the present invention.

Figure 2A and Figure 2B are schematic illustrations according to a second aspect of the present invention.

PREFERRED EMBODIMENTS OF THE INVENTION

In accordance with a first embodiment of the invention as shown in **Fig. 1**, there is provided a composite board 10 between 20-50mm thickness (T). The composite board 10 comprises five layers of various material compositions: a middle core layer 16 sandwiched between intermediate second layer 14 and fourth layer 18, and outer first layer 12 and last layer 20 cladding the intermediate second layer 14 and fourth layer 18. The first layer 12 and the last layer 20 are made of polyethylene not exceeding 5mm. The intermediate second layer 14 and fourth layer 18 are made of aluminium sheeting not exceeding 3mm thickness. The core layer 16 is made of plywood. The core layer has a thickness of 14.4mm.

As shown in Figure 2A, each layer is thermally bonded to the layer below by adhesives to provide additional strength to the composite board 10 and to make the resulting composite board 10 waterproof. The bonding technique employed in this embodiment is hot-melt system whereby hot-melt adhesive films of about 0.02mm to 0.5mm thick are used. The adhesive film may consist of a single layer or multiple layers, each layer being formed of a different composition. The choice of the composition of the adhesive film or layers depends on the types of materials to be bonded. The adhesives are applied evenly on each layer. In this manner, first layer 12 is thermally bonded by adhesive to intermediate second layer 14, which is in turn thermally bonded by adhesive to core layer 16 and so on. After applying the adhesive films on each layer to be bonded, a focused heating zone is applied between the bonding layers as the bonding layers are being fed between rollers for lamination. The localized heating temperature applied at the bonding joint is higher than the softening temperature of the plastic layer, and preferably 10

°C higher than the softening temperature of the plastic layer. After passing through the rollers, the laminated composite board is left to cure the adhesive films.

In accordance with a second embodiment of the invention (not shown), there is provided a composite board 10 of 12mm thickness (T). The composite board 10 comprises three layers of various material compositions: a middle core layer 16 sandwiched between outer first layer 12 and last layer 20. The first layer 12 and the last layer 20 are made of polyethylene to a thickness of 2mm. The core layer 16 is made of plywood. The core layer has a thickness of 10mm.

As shown in Figure 2B, each layer is thermally bonded to the layer below by adhesives to provide additional strength to the composite board 10 and to make the resulting composite board 10 waterproof. Similar to the five-layered composite board, the bonding technique employed in this embodiment is hot-melt system whereby hot-melt adhesive films of about 0.02mm to 0.5mm thick are used. The adhesive film may consist of a single layer or multiple layers, each layer being formed of a different composition. The choice of the composition of the adhesive film or layers depends on the types of materials to be bonded. The adhesives are applied evenly on each layer. In this manner, first layer 12 is thermally bonded by adhesive to the core layer 16 and so on. After applying the adhesive films on either layer to be bonded, a focused heating zone is applied between the bonding layers as the bonding layers are being fed between rollers for lamination. The localized heating temperature applied at the bonding joint is higher than the softening temperature of the plastic layer, and preferably 10 °C higher than the softening temperature of the plastic layer. After passing through the rollers, the laminated composite board is left to cure the adhesive films.

The applicant has found that the re-use cycle of composite boards made in accordance with the invention, and used as shuttering boards, ranges from 200 to 500 uses. Furthermore, such composite shuttering boards are completely recyclable.

The inherent strength of the composite boards also makes them suitable for other uses such as non-load bearing walls, scaffolding boards, floor decking, roofing shelters and truck cabins. The inherent high strength is attributable to the hot-melt system employed. In particular, the hot-melt system is useful for low surface

energy plastics (typically having surface energy of less than 35 on a dyne scale) such as polyethylene whereby conventional adhesive glue or epoxy glue do not provide good bonding strength between the laminated wood and plastic layers, or between metal and plastic layers. By providing a focused heating zone between the bonding layers as the bonding layers are being fed continuously between rollers, heat is provided consistently, uniformly and directly to the bonding joint between the bonding layers. The hot-melt system affords ease of production, good bonding strength, and the ability of the adhesive bond to withstand functional use of the product with the bond being waterproof, the ability to withstand high impact stress and the ability to maintain the bond integrity during temperature change.

It should be appreciated by the person skilled in the art that the above invention is not limited to the embodiment described. In particular, the following modifications and improvements may be made without departing from the scope of the present invention:

- The polyethylene material used in the first and last layers may be replaced with other hard plastic materials such as polyvinyl chloride or polypropylene.

- The material used in the core layer may be of virgin or recycled origin. In this manner, new composite boards may be made by recycling the material used in older composite boards.

- The thickness of the composite board may vary from the 20-50mm described above. While the preferred thickness range identified by the applicant is from 9mm to 30mm thickness, boards of other sizes may just as easily be created.

- The thickness of the first and last layers should be limited to a maximum of 2mm for any composite board less than or equal to 50mm in thickness (total).

- The thickness of the core layer, as a proportion of the total thickness of the composite board, should be roughly 80%.

- The composite board may have a groove cut along each edge adapted to receive an edge bander made of a plastic material. By edge-banding the board in this manner, the edges of the board are protected during handling and usage – thereby also further prolonging the lifespan of the board. The plastic material that may be used for the edge bander includes polyvinyl chloride, polyethylene, polypropylene and rubber.

- The whole composite board may be applied under heavy loads for a certain duration until the adhesives are set.

- The hot-melt adhesive film may be applied on the plastic layer alone, or the core wood layer alone, or both layers.

It should be further appreciated by the person skilled in the art that the features described above, where not mutually exclusive, can be combined to form yet further embodiments of the invention.

We Claim:

1. A composite board comprising:

   a first layer of material consisting of one material from a first hard plastic material set;

   a second layer consisting of a metal having at least a substantially high strength to weight ratio;

   a third layer of material consisting of a wood material;

   a fourth layer consisting of a metal having at least a substantially high strength to weight ratio;

   a fifth layer of material consisting of one material from the first hard plastic material set,

   where the layers are bonded in a sequential fashion and the resulting board is laminated.

2. A composite board according to claim 1, where the first hard plastic material set comprises the materials: polyethylene; polypropylene; polyvinyl chlorate.

3. A composite board according to either claim 1 or claim 2, where the third layer of material is a wooden board or plywood.

4. A composite board according to any preceding claim, where the third layer is made up of aluminium sheeting.

5. A composite board according to any preceding claim where the total thickness of the composite board is between 9 and 30mm.

6. A composite board according to claim 5, where the total thickness of the composite board is between 10 and 18mm.

7. A composite board according to claim 5 or claim 6, where the thickness of the first and fifth layers does not exceed 2 mm.

8. A composite board according to any preceding claim, where the thickness of the third layer represents substantially 80% of the total thickness of the composite board.

9. A composite board according to any preceding claim where each layer is thermally bonded to the next layer in sequence.

10. A composite board according to claim 9, where the bonding agent used is waterproof.

11. A composite board according to any preceding claim, where the material used in the first layer is the same as the material used in the fifth layer.

12. A composite board according to any preceding claim, where the metal used in the second layer is the same as the metal used in the fourth layer.

13. A method of producing a composite board comprising the steps of:

bonding a first layer made of a material from a first hard plastic material set to a second layer made of a metal having at least a substantially high strength to weight ratio;

bonding the second layer to a third layer made of a wood material;

bonding the third layer to a fourth layer made of a metal having at least a substantially high strength to weight ratio; and

bonding the fourth layer to a fifth layer made of a material from a first hard plastic material set; and

laminating the bonded board.

14. A composite board substantially as described herein with reference to the drawings.

15. A method of producing a composite board substantially as described herein with reference to the drawings.