
DOUBLE SHEET ALUMINUM PANEL AND METHOD FOR MANUFACTURE THEREOF

Description

The present invention relates to a double sheet aluminum panel according to the subject-matter of independent claim 1. Furthermore, the invention provides a method for manufacturing such a double sheet aluminum panel.

5 Due to their exceptional mechanical properties, composite panels have a wide variety of application such as aircraft construction or architecture. In architecture, for instance, composite panels are used for external walls, shop awnings, signage and ceilings. Depending on their composition, composite panels can exhibit many advantageous features such as being weather proof, noise
10 absorbing, fireproof, light and easy to cut, impact resistant and easy to maintain. Composite panels are also known as sandwich elements, as they commonly consist of a plurality of different layers arranged on top of each other. In many cases, composite panels exhibit at least three layers, in particular a core layer as well as two outer layers attached to either side of the core.

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Above all, aluminum composite panels are utilized in architectural applications, such as the cladding of buildings. Although, aluminum composite panels are exceedingly light weight, they exhibit high durability and are easy to process. In consequence of their application in hospitals, tunnels and stadiums, however,
20 there is a need for composite panels which are incombustible. This requirement is specified within the European-standard EN 13501-1. Depending on properties like

fire performance, smoke generation, burning droplets etc. materials are classified in different categories. A general view of the different classes specified by the European standard, in comparison with the national standards in Germany and France, is depicted in table 1 (effective July 2010).

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Flammability	Europe (EN-13501)	Germany (DIN 4102)	France (NF-P92501)
Non-flammable	A1, A2-s1 d0	A1, A2	M0
Low flammability	A2-s2 d0, B, C	B1	M1, M2
Moderate flammability	D, E	B2	M3
High flammability	F	B3	M4

Table 1: Overview of European, German, French flammability classification

10 In order to provide a material that fulfils the criteria to be non-combustible, it must be classified as A1 or A2 – s1 d0 (s = smoke generation, d = burning droplets), according to the European standard EN-13501. In this regard, the core material is subjected to various tests, such as the measurement of its calorific value, defined by ISO 1716. As to that, the requirement for a classification of
15 non-flammability, according to the European standard, is a heat of combustion that does not exceed 3.0 MJ/kg. By contrast, the French standard even stipulates a heat of combustion no higher than 2.5 MJ/kg in order to obtain a “M0” classification for tested product.

20 In order to achieve these ambitious requirements of the European standard EN 13501, composite panels known from the state of the art comprise metallic or non-metallic strips that are attached to both sides of the core layer, which comprises very specific compositions of non-flammable materials. In particular, these known composite panels frequently use organic or inorganic, non-
25 flammable materials in order to build the core layer. However, these core layers of organic or inorganic nature are comparatively heavy and lead to a lack of flexibility, those are often not capable of absorbing the deformations resulting from mechanical stresses due to thermal expansions of the cover layers. Moreover, the common composite panel, having a relatively thick core layer,
30 often requires a substantial effort in order to manufacture the latter.

On the basis of the problems outlined above, it is an object of the present invention to provide a non-combustible aluminum panel, fulfilling the European, German and French standard, which is easy to produce and exhibits a flexibility, which is capable of absorbing the deformations resulting from mechanical stresses of the cover layers. Furthermore, it is an objective to provide an aluminum panel, which is particularly easy to handle.

To this end, the invention relates to a double sheet aluminum panel, which consists of two aluminum layers attached to each other by means of an adhesive layer disposed there between. In more detail, the double sheet aluminum panel of the present invention consists of a first layer of a first aluminum material attached to a second layer of a second aluminum material. The first and second layers are attached to each other by means of an adhesive layer disposed between the first and second layer.

In other words, the present invention does not comprise a particular core layer comprising organic and/or inorganic ingredients in order to provide non-flammability of the aluminum sheet panel. Rather, it was surprisingly discovered that a double sheet aluminum panel consisting of two aluminum layers attached to each other by means of an adhesive layer, at least fulfils the requirements of the A2 – s1,d0 /A2 / M0 class according to European, German and French fire certifications.

In general, the adhesive layer of the present invention may be of type such as an epoxy, acrylic, phenolic, polysulfone or polyimide resin. Preferably, however, the adhesive layer may comprise a thermoplastic or most preferably a thermosetting polymer. It was found that using a thermosetting polymer adhesive provides for a strong bond, whilst the non-flammability of the inventive composite panel is maintained.

Of course, the double sheet aluminum panel according to the present invention exhibits various advantages compared with the commonly known composite panels. In particular, the inventive double sheet aluminum panel is particularly easy to produce and provides for a low-cost option for producing cladding elements. In more detail, the double sheet aluminum panel of the present invention exhibits similar mechanical properties compared to a monolithic panel. In absence of various materials combined as a core layer, the double sheet

aluminum panel of the present invention is lightweight, that is easy to handle especially when being used for the cladding of a modern high-rise building. Of course, the present composite panel is also comparatively easy to produce. In some instances, it may even be cheaper to produce the inventive double sheet
5 aluminum panel instead of a monolithic aluminum panel having the same thickness. Finally, it should be noted that the double sheet aluminum panel of the present invention is fully recyclable and thus particularly environment friendly.

Further embodiments according to the present invention are described in the
10 dependent claims.

In accordance with one aspect of the invention, the adhesive layer is composed of a first adhesive layer, provided on an inner side of the first layer of aluminum material, wherein said inner side faces the second layer of aluminum material.

15 Moreover, a second adhesive layer is provided on an inner side of the second layer of aluminum material, which faces the first layer of aluminum material. In this regard, it is possible, that the first adhesive layer is made of an adhesive material, which is different from the adhesive material of the second adhesive layer. Hence, the double sheet aluminum panel can be designed in accordance
20 with individual requirements.

In a preferred embodiment of the inventive double sheet aluminum panel, the adhesive layer has a total thickness of not more than 90 μm , preferably not more than 80 μm . In this regard, the calorific value of the adhesive material of the
25 adhesive layer is reduced such that the double sheet aluminum panel meets the requirements of the flammability classification.

In accordance with one aspect of the present invention, the adhesive layer consists of an adhesive material having a calorific value of less than 55 MJ/kg,
30 preferably less than 50 MJ/kg, and more preferably less than 45 MJ/kg.

Alternatively or in addition thereto, in exemplary embodiments of the double sheet aluminum panel, the mass distribution of the adhesive material is between 0,02 g/m² and 0,1 g/m², preferably between 0,05 g/m² and 0,08 g/m², and more
35 preferably approximately 0,07 g/m².

In accordance with a further aspect of the present invention, a protective layer is provided on the inner side of at least one of the first and second layer of aluminum material, wherein said protective layer preferably comprises epoxy resin. By having a protective layer applied preferably on each aluminium layer skins, the aluminium panel offers the ability to be perforated, without having some delamination due to water penetration.

In some embodiments of the present invention, the thickness of the protective layer is adapted to the thickness of the adhesive layer. In this regard, the thickness of the protective layer and the thickness of the adhesive layer may be chosen such that the cumulated caloric value of both layers does not exceed a predetermined maximum value. The predetermined maximum value of the cumulated caloric value is, for example less than 6 MJ/m², and preferably 4 MJ/m².

Accordingly, the different layers (adhesive layers and protective layers) between both aluminum skins are considered as being a non-substantial component. That means that the caloric value (PCS) of each layer can be cumulated and compared to the maximum level of 4 MJ/m² authorized to pass the classification according to EN13501.

In some embodiments, the protective layer may have a thickness of between 3 µm to 10 µm, and preferably of between 5 µm to 7 µm.

The protective layer may consists of an epoxy material having a calorific value of less than 40 MJ/kg, preferably less than 35 MJ/kg, and more preferably less than 30 MJ/kg.

In some embodiments of the present invention, the mass distribution of the epoxy material is between 5 g/m² and 9 g/m², preferably between 6 g/m² and 8 g/m², and more preferably approximately 7 g/m².

In accordance with exemplary embodiments of the double sheet aluminum panel, the total thickness of both, the adhesive layer and the protective layer on at least one of the first and second layers of aluminum material does not exceed 100 µm, preferably not 80 µm and most preferably not 70 µm.

In accordance with some aspects of the invention, an outer layer is provided on the outer side of at least one of the first and second layers of aluminum material, wherein the outer layer is preferably a coating comprising polyester. In exemplary embodiments, the outer layer has a thickness of between 20 μm to 50 μm , and preferably a thickness of approximately 30 μm to 40 μm .

In some embodiments of the present invention, the outer layer consists of a polyester material having a calorific value of less than 18 MJ/kg, preferably less than 16 MJ/kg, and more preferably less than 14 MJ/kg. The mass distribution of the polyester material may be between 35 g/m² and 75 g/m², preferably between 45 g/m² and 65 g/m² and more preferably approximately 55 g/m².

According to a further embodiment of the inventive double sheet aluminum panel, the first aluminum material is substantially the same as the second aluminum material. In this regard, it should be noted that "substantially the same" refers to the fact that any aluminum material produced, whether it is "pure" aluminum or an aluminum alloy, comprises impurities to at least some degree. Substantially the same, therefore, means that the first and second aluminum materials are produced in the same way so as to exhibit almost identical structures.

Alternatively it is also conceivable that the first aluminum material is different from the second aluminum material. In particular, it may be desirable to provide a bright finishing aluminum of an aluminum or aluminum alloy as the first aluminum material, which is attached to the second layer made of the second aluminum material being composed of a high strength aluminum or aluminum alloy. In this way, the present invention provides for a bright finish high strength aluminum or aluminum alloy panel, which is particularly lightweight.

With reference to another aspect of the present invention, the first and/or the second layer of the double sheet aluminum panel comprise cover layers on their outer surfaces. These cover layers may be paint layers, in order to increase the aesthetic appearance of the panel. The cover layers may be produced from flammable and/or non-flammable material as long as the non-flammability of the aluminum panel is maintained. The cover layers may be applied in any known manner, such as wet paint or strips of painted material applied to the outer surfaces of the first and/or second layer.

The aluminum material of the first and second layers may be any aluminum material, i.e. pure or alloys, known in the state of the art. However, according to another embodiment, it is preferred to produce the first and second layers of the inventive double sheet aluminum panel from aluminum-magnesium or aluminum-manganese alloys, which are both lighter than other aluminum alloys and much less flammable. In more detail, the first and/or second aluminum material of the first/second layer can be made from a 3.000 or 5.000 series aluminum alloy.

In another embodiment of the present invention, the first and second layers of the double sheet aluminum panel comprise substantially the same thickness. Preferably, both, the first and second layers comprise a thickness which is between 0.5 and 5 mm preferably between 1 and 3 mm and in particular 1.25 mm, 1.5 mm or 2 mm. Most preferably, the thickness of the first and second layers is 1.5 mm, so as to produce a double sheet aluminum panel which is about 3 mm thick. Alternatively, it is also conceivable that the first and second layers comprise a different thickness. In this regard, it should be noted, that the double sheet aluminum panel preferably has a total thickness of 1 to 10 mm, preferably 2 mm, 2.5 mm or 3 mm. Consequently, the first and second layers are complementary to each other so as to produce a double sheet aluminum panel which has the preferred thickness between 1.5 to 10 mm. Most preferably the double sheet aluminum panel is constructed to be about 3 mm thick.

In accordance with some aspects of the present invention, the first and/or second layer of aluminum material has a thickness of between 0,8 mm and 2,5 mm, preferably between 1,5 mm and 2,0 mm, and more preferably of approximately 1,5 mm. In this regard, a double sheet aluminum panel can be achieved, which has a thickness of between 1 mm and 10 mm, preferably between 2 mm and 7 mm, and more preferably between 2,5 mm and 5 mm.

In some embodiments, the double sheet aluminum panel comprises at least one opening penetrating at least the first and second layers of aluminum material. For example, the double sheet aluminum panel may be perforated.

As already indicated before, the present invention also relates to a method, manufacturing a double sheet aluminum panel for cladding elements comprising the following steps:

- providing a sheet of a first aluminum material;
 - providing a sheet of a second aluminum material;
 - applying an adhesive to inner surfaces of the first and/or the second layers;
- 5 - roll bonding the first and second sheets together along their inner surfaces to form a laminate aluminum sheet consisting of two layers of aluminum material attached to each other by means of the adhesive;
- cutting the laminate aluminum sheet into double sheet aluminum panels.
- 10 With the aforementioned method, the inventive double sheet aluminum panel can be produced easily in a most cost-efficient manner. Furthermore, due to the roll bonding of the first and second sheets, the aluminum sheets or layers can be bonded together continuously in a composite line. After the roll bonding process, the continuous laminate composite product can be cut into panels of varying sizes
- 15 in accordance with a potential costumer's needs.

Since the adhesive is preferably a thermosetting polymer, it is heated and cured before roll bonding is performed. In particular, the adhesive may be applied to the inner surfaces of the first and/or second layers, heated and cured before the

20 first and second layers arrive at the rollers of the roll bonding apparatus. The adhesive may be heated together with the first and second layers up to a temperature of 250 C°.

According to another aspect of the present invention, the method may comprise a

25 step for smoothening at least the inner surfaces of the first and second layers by means of abrasion before the adhesive is applied. Additionally, the first and second layers may be suspected to an alkaline, so as to clean the surface before application of the adhesive. Furthermore, the aluminum layers may be subjected to an anodizing step. In particular, the aluminum layers may be passed through a

30 series of chemical baths. The first bath, the chemical degreaser/cleaner stage, cleans the aluminum of all oils, grease, loose oxides, etc. in order to promote the growth of a uniform anodic layer. The next stage may be a rinse stage, which removes any cleaning residue from the first and second layers. Thereafter, the first and second layers could be passed through a second bath with phosphoric

35 acid as an anodizing substance. After anodizing, the aluminum layers are again rinsed to remove remaining anodizing solution. Finally, the first and second layers may be dried before applying the adhesive to the inner surfaces thereof.

According to another embodiment, at least the inner surfaces of the first and second layers are treated with a conversion coating before the adhesive is applied. The purpose of the conversion coating is to enhance the corrosion resistance of the final product and to improve the strength of the bond between the two aluminum layers. The solutions applied as conversion coatings can comprise hexavalent chromium, fluoride ions, tungsten, vanadium or molybdenum. The conversion coating may be applied by spraying the conversion coating solution onto the at least inner surface of the first and second layers, running the first and second layers through a bath of conversion coating solution or applying the conversion coating solution to the aluminum surfaces with one or more rollers. After the conversion coating has been applied to the surfaces of first and second layers, the substrate generally has to be dried before the adhesive is applied.

The adhesive application can be performed by any technique known by the state of the art. In particular, such techniques may include roll coating, reversal coating, spraying, impregnation coating, folding etc.

In addition to the aforementioned method steps, the first and/or second layers may be heat treated before roll bonding is performed. Alternatively or additionally, the first and second layers may pre-stressed, before the adhesive is applied. In particular, the first and second layers may be stressed more than the specific elastic elongation of the aluminum material and less than the specific brake elongation. In the following, the inventive double sheet aluminum panel and method for manufacturing the double sheet aluminum panel is explained in more detail with reference to the exemplary embodiments shown.

The Figures show:

Fig. 1a a schematic sectional view of a double sheet aluminum panel according to a first embodiment of the present invention;

Fig. 1b a schematic sectional view of a double sheet aluminum panel according to a second embodiment of the present invention;

Fig. 2 a schematic view of an apparatus for manufacturing a double sheet aluminum panel according to the inventive method; and

5 Fig. 3 a schematic sectional view of a double sheet aluminum panel according a third embodiment of the present invention.

Figures 1a and 1b show first and second embodiments of a double sheet aluminum panel in accordance with the present invention. In particular, the double sheet aluminum panels shown in Figures 1a and 1b consist of a first layer 2 of a first aluminum material attached to a second layer 4 of a second aluminum material. The first and second layers 2, 4 are attached to each other by means of an adhesive layer 3, which is disposed between the first and second layers 2, 4. The adhesive layer 3 may preferably comprises a thermosetting polymer adhesive. As will be described in more detail below with reference to Fig. 2, the adhesive layer 3 may be composed of 2 individual adhesive layers 3-1, 3-2 combined during roll bonding.

As already mentioned above, the first aluminum material is preferably substantially the same as the second aluminum material. In particular, the first aluminum material and second aluminum material of the first and second layers 2, 4 are preferably made from a 3.000 or 5.000 series aluminum alloy.

In the first embodiment according to Fig. 1a, the first and second layers 2, 4 comprise substantially the same thickness. In more detail, the first and second layers may comprise a thickness of 1.5 mm, so as to provide for a double sheet aluminum panel having a thickness of 3 mm. Of course, the adhesive layer 3 does not significantly contribute to the thickness of the double sheet aluminum panel. Rather, the thickness of the adhesive layer 3, depicted in Figures 1a and 1b is illustrated schematically and not to measure.

Fig. 1b, on the other hand, shows a second embodiment of the double sheet aluminum panel, wherein the first and second layers 2, 4 comprise a different thickness. According to this embodiment, the first layer 2 is thinner than the second layer 4 such that mainly the second layer 4 provides for the mechanical properties of the double sheet aluminum panel 1 and allows larger possibility in terms of formability.

Figures 1a and 1b additionally illustrate that the first and second layers 2, 4 may comprise outer layers 6, 7 which may be decorative layers of paint, printed vinyl, polyester, polyurethane, polyolefin, paper or any combination thereof. Preferably, the decorative layers may consist of paint that simulates various building materials including but not limited to wood grain patterns, stone, rock, any type of painted surfaces, etc.

Another embodiment is schematically shown in Fig. 3. The double sheet aluminum panel 1 depicted in Fig. 3 mostly corresponds to the aluminum panel of Fig. 1a.

Hence, the double sheet aluminum panel 1 comprises a first layer 2 of aluminum material, and a second layer 4 of aluminum material, and a second layer 4 of aluminum material, wherein the first and second layers 2, 4 of aluminum material are attached to each other by means of an adhesive layer 3. The adhesive layer 3 consists of a first adhesive layer 3a, which is provided on an inner surface of the first layer 2 of aluminum material, and a second adhesive layer 3b, which is provided on an inner surface of the second layer 4 of aluminum material.

Moreover, the double sheet aluminum panel 1 according to exemplary embodiment depicted in Fig. 3 is provided with a first protective layer 8a, which is arranged between the inner side of the first layer 2 of aluminum material and the first adhesive layer 3a. Furthermore, a second protective layer 8b is provided between the inner side of the second layer 4 of aluminum material and the second adhesive layer 3. The protective layer 8a, b comprise epoxy resin and surf for protecting the aluminum material of the first and second layers 2, 4.

Moreover, an outer layer 6 is provided on the outer side of the first layer 2 of aluminum material. Another outer layer 7 is provided on the outer side of the second layer 4 of aluminum material. The outer layers 6, 7 are preferably a coating comprising polyester.

In the exemplary embodiment depicted in Fig. 3 of the present invention, the adhesive layer 3 has a total thickness of not more than 90 μm . Moreover, the adhesive layer 3 consists of an adhesive material having a calorific value of less than 55 MJ/kg. The mass distribution of the adhesive material is between 0,02 g/m² and 0,10 g/m².

On the other hand, each of the protective layers 8a, b has a thickness of between 3 μm to 10 μm . The protective layers 8a, b respectively consists of an epoxy material having a calorific value of less than 40 MJ/kg, wherein the mass distribution of the epoxy material is between 5 g/m² and 9 g/m².

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Each of the outer layer 6, 7 has a thickness of between 20 μm to 50 μm . The outer layer 6, 7 respectively consists of a polyester material having a calorific value less than 18 MJ/kg. The mass distribution of the polyester material is between 35 g/m² and 75 g/m².

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A method and apparatus for manufacturing the double sheet aluminum panel 1 in accordance with the present invention is schematically shown by Fig. 2. According to the method of the present invention, first and second sheets 20, 40 of first and second aluminum materials are provided. As can be seen from the schematic drawing, these sheets of aluminum material may be provided on coils 11, 21. Alternatively, the aluminum sheets may be provided directly after production thereof.

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The first and second aluminum sheets 20, 40 may be pre-treated by optional pre-treating sections 12, 22. As mentioned before, such pre-treatment may include smoothening, cleaning, anodization, heat treatment or pre-stressing of the first and second sheets 20, 40. Afterwards, the outer and inner surfaces of the pre-treated sheets 20, 40 may be treated with a conversion coating at conversion coating sections 13, 23. Subsequently, the outer and inner surfaces of treated sheets 20, 40 may be painted at painting sections 14, 24. It should be noted, that all of the aforementioned sections 12, 13, 14, 22, 23 and 24 are completely optional and not necessarily part of the inventive method.

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The treated aluminum sheets 20, 30 are then passed through an adhesive roll coater operation to apply an adhesive layer 3-1, 3-2. At a tray 17, 27 an adhesive is gathered by a pick-up roll 26, which transfers the adhesive solution to an applicator roll 15, 25. The applicator roll 15, 25 applies the adhesive solution to the moving sheets 20, 40, preferably rotating in opposite directions, e.g. such as by a revers roll coater.

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Of course, it is also conceivable to apply the adhesive solution by other methods such as by spraying but roll application is considered to be the best for a uniform

thin coating. The adhesive coated sheets 20, 40 are subsequently cured in curing section 18, 28 to form two individual sheets with a respective adhesive layer 3-1, 3-2, preferably thermoset adhesive layers.

- 5 After applying the adhesive to the inner surfaces of the first and second sheets 20, 40, the sheets are subjected to a roll bonding process at pressure rollers 19, 29 so as to form a roll bonded laminate composite sheet 5.

- 10 As a last step, the laminate composite sheet 5 is introduced into a post processing section 30, in which the laminate composite sheet 5 may be cooled, cut and stacked into individual double sheet aluminum panels according to the present invention. In this regard, it should be noted that the method of the present invention provides for a continuous production of double sheet aluminum panels in accordance with the present invention.

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The present invention is not limited to the specific embodiments shown in the respective Figures.

List of references

	1	double sheet aluminum panel
5	2	first layer
	3	adhesive layer
	3 a, b	first, second adhesive layer
	4	second layer
	5	laminate composite sheet
10	6, 7	outer layer
	8a, b	protective layer
	11, 21	coil of aluminum sheet
	12, 22	pre-treating section
	13, 23	conversion coating application section
15	14, 24	painting section
	15, 25	applicator roll
	16, 26	pick-up roll
	17, 27	tray
	18, 28	curing section
20	19, 29	pressure roll
	20	first aluminum sheet
	30	post treatment section
	40	second aluminum sheet

DOUBLE SHEET ALUMINUM PANEL AND METHOD FOR MANUFACTURE THEREOF

Claims

1. A double sheet aluminum panel (1) consisting of a first layer (2) of a first aluminum material attached to a second layer (4) of a second aluminum material, the first and second layers being attached to each other by means of an adhesive layer (3) disposed between the first and second layers (2, 4).
2. The double sheet aluminum panel (1) according to claim 1, wherein the adhesive layer (3) comprises polyethylen.
3. The double sheet aluminum panel (1) according to claim 1 or 2, wherein the adhesive layer (3) is composed of a first adhesive layer (3a) provided on an inner side of the first layer (2) of aluminum material facing the second layer (4) of aluminum material, and a second adhesive layer (3b) provided on an inner side of the second layer (4) of aluminum material facing the first layer (2) of aluminum material.
4. The double sheet aluminum panel (1) according to claim 3, wherein the first adhesive layer (3a) is made of an adhesive material, which is different from the adhesive material of the second adhesive layer (3b).

5. The double sheet aluminum panel (1) according to one of the claims 1 to 4, wherein the adhesive layer (3) has a total thickness of not more than 90 μm , preferably not more than 80 μm .
6. The double sheet aluminum panel (1) according to one of the claims 1 to 5, wherein the adhesive layer (3) consists of an adhesive material having a calorific value of less than 55 MJ/kg, preferably less than 50 MJ/kg, and more preferably less than 45 MJ/kg.
7. The double sheet aluminum panel (1) according to one of the claims 1 to 6, wherein the mass distribution of the adhesive material is between 0,02 g/m² and 0,10 g/m², preferably between 0,05 g/m² and 0,08 g/m², and more preferably approximately 0,07 g/m².
8. The double sheet aluminum panel (1) according to one of the claims 1 to 7, wherein a protective layer (8a, b) is provided on the inner side of at least one of the first and second layers (2, 4) of aluminum material, said protective layer preferably comprises epoxy resin.
9. The double sheet aluminum panel (1) according to claim 8, wherein the protective layer has a thickness, the thickness of the protective layer being adapted to the thickness of the adhesive layer (3).
10. The double sheet aluminum panel (1) according to claim 8 or 9, wherein the thickness of the protective layer and the thickness of the adhesive layer (3) are chosen such that the cumulated caloric value of both layers does not exceed a predetermined maximum value.
11. The double sheet aluminum panel (1) according to claim 10, wherein the predetermined maximum value of the cumulated caloric value is less than 6 MJ/m² and preferably 4 MJ/m².
12. The double sheet aluminum panel (1) according to one of the claims 8 to 11, wherein the protective layer has a thickness of between 3 μm to 10 μm , preferably of between 5 μm to 7 μm .

13. The double sheet aluminum panel (1) according to one of the claims 8 to 12, wherein the protective layer consists of an epoxy material having a calorific value of less than 40 MJ/kg, preferably less than 35 MJ/kg, and more preferably less than 30 MJ/kg.
14. The double sheet aluminum panel (1) according to one of the claims 8 to 13, wherein the mass distribution of the epoxy material is between 5 g/m² and 9 g/m² preferably between 6 g/m² and 8 g/m² and more preferably approximately 7 g/m².
15. The double sheet aluminum panel (1) according to one of the claims 8 to 14, wherein the total thickness of both, the adhesive layer (3) and the protective layer on at least one of the first and second layers (2, 4) of aluminum material does not exceed 100 µm, preferably not 80 µm and most preferably not 70 µm.
16. The double sheet aluminum panel (1) according to one of the claims 1 to 15, wherein an outer layer (6, 7) is provided on the outer side of at least one of the first and second layers (2, 4) of aluminum material, the outer layer (6, 7) being preferably a coating comprising polyester.
17. The double sheet aluminum panel (1) according to claim 16, wherein the outer payer (6, 7) has a thickness of between 20 µm to 50 µm, and preferably a thickness of approximately 30 µm to 40 µm.
18. The double sheet aluminum panel (1) according to claim 16 or 17, wherein the outer layer (6, 7) consists of a polyester material having a calorific value of less than 18 MJ/kg, preferably less than 16 MJ/kg, and more preferably less than 14 MJ/kg.
19. The double sheet aluminum panel (1) according to one of the claims 16 to 18, wherein the mass distribution of the polyester material is between 35 g/m² and 75 g/m², preferably between 45 g/m² and 65 g/m², and more preferably approximately 55 g/m².

20. The double sheet aluminum panel (1) according to one of the claims 1 to 19, wherein the first aluminum material is substantially the same as the second aluminum material.
21. The double sheet aluminum panel (1) according to one of the claims 1 to 19, wherein the first aluminum material is different from the second aluminum material.
22. The double sheet aluminum panel (1) according to claim 20 or 21, wherein the first aluminum material of the first layer (2) is a 3000 or 5000 series aluminum alloy.
23. The double sheet aluminum panel (1) according to one of the claims 20 to 22, wherein the second aluminum material of the second layer (4) is a 3000 or 5000 series aluminum alloy.
24. The double sheet aluminum panel (1) according to one of the claims 1 to 23, wherein the first and second layers (2, 4) comprise substantially the same thickness.
25. The double sheet aluminum panel (1) according to one of the claims 1 to 24, wherein the first and second layers (2, 4) comprise a different thickness.
26. The double sheet aluminum panel (1) according to one of the claims 1 to 25, wherein the first and/or second layer (2, 4) of aluminum material has a thickness of between 0,8 mm and 2,5 mm, preferably between 1,0 mm and 2,0 mm, and more preferably of approximately 1,5 mm.
27. The double sheet aluminum panel (1) according to one of the claims 1 to 26, wherein the double sheet aluminum panel (1) has a thickness of between 1 mm and 10 mm, preferably between 2 mm and 7 mm, and more preferably between 2,5 mm and 5 mm.
28. The double sheet aluminum panel (1) according to one of the claims 1 to 27, wherein the double sheet aluminum panel (1) comprises at least one opening penetrating at least the first and second layers (2, 4) of aluminum material.

29. The double sheet aluminum panel (1) according to one of the claims 1 to 28, wherein the double sheet aluminum panel (1) is perforated.
30. A method for manufacturing a double sheet aluminum panel according to one of the claims 1 to 29, the method comprising the following steps:
- providing a first sheet of a first aluminum material;
 - providing a second sheet of a second aluminum material;
 - applying an adhesive to inner surfaces of the first and/or second layers;
 - roll bonding the first and second sheets together along their inner surfaces to form a laminate aluminum sheet consisting of two layers of aluminum material attached to each other by means of the adhesive;
 - cutting the laminate aluminum sheet into double sheet aluminum panels.
31. The method according to claim 30, wherein the adhesive is heated before roll bonding is performed.
32. The method according to claim 30 or 31, wherein at least the inner surfaces of the first and second layers are smoothened by means of abrasion before the adhesive is applied.
33. The method according to one of the claims 30 to 32, wherein at least the inner surfaces of the first and second layers are treated with conversion coating before the adhesive is applied.
34. The method according to one of the claims 30 to 33, wherein at least the outer surfaces of the first and second layers are treated with paint before the adhesive is applied.
35. The method according to one of the claims 30 to 34, wherein rolling is performed by means of pressure rollers in such a way that a double sheet aluminum panel having a thickness of 1 to 10 mm is produced.