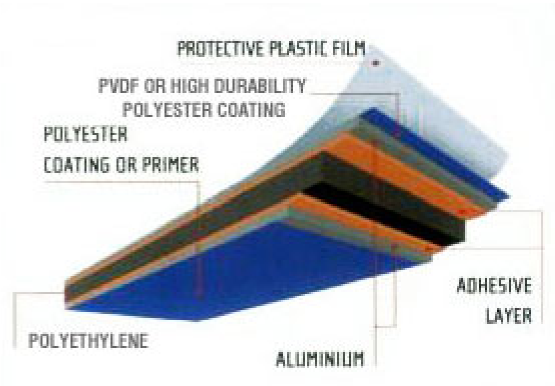
ALUMINIUM COMPOSITE PANELS ARTICLE

History of ACP:

Aluminium Composite Panels (ACP) were introduced in 1969 by company Alusingen, as a joint-invention with BASF. Alusingen was bought by Alusuisse which was then subsequently acquired by the giant multinational firm Alcan in 2000 (today Rio Tinto). The brand Alucobond has been since then synonymous to the product, like “Jeep” or “Rockwool”. Alusingen patented the process of Alucobond for 20 years, that was between 1971 and 1991.

Upon the expiry of the patent, several players have then entered the field, such as Alcoa (brand Reynobond), Etem (brand Etalbond),Mitsubishi (brand Alpolic) etc. The industry used to be knowledge intensive until the first years of this century, but then the technology was widely diffused and several smaller producers arised.

The material is essentially comprised with two aluminium sheets thickness 0,5 mm, and low-density polyethylene (LDPE) 3 mm thickness. Total thickness, along with adhesive layers and glues, is 4 mm.



Picture 1: Composition of ACP

There are mainly 3 technologies for processing: coextrusion, lamination with pre-made adhesive films and extrusion lamination.

In spite of the invention of the product in 1969, it was not until the mid 80s that the mainstream architecture discovered the use of the material. The main advantages for the use, were:

- ✓ Light weight and impressive strength-to-weight ratio
- ✓ Material adaptability and flexibility
- ✓ Durability
- ✓ Harmony with the environment
- ✓ Variety of colours

Picture 2: One of the first projects with ACP

Upon the expiry of the patent, the product became widely commercialized, as well as more economically efficient. So, along with aluminium curtain-walls and glass, ACP materials dominated the façade industry and there are many modern cities that have been built almost entirely with these materials.
Until today, the impressive Burj el Arab, symbol of the city of Dubai, remains the benchmark project for ACP.

Picture 3: Burj el Arab Hotel, Dubai, UAE

During the first decade of the century, new applications were added in the industry, such as C.ID. (Corporate Identity) projects. Several car manufacturers, as well as many oil gas companies used this material, some times painted with their own corporate colours.

Picture 4: IKEA

Picture 5: Shell CID

Picture 6: Mitsubishi

Market:

In 2005, the market for ACP was officially amounted to 16 million m2 (production in Europe). Globally, it is estimated at around 30 million m2 –at least before the crisis. Largest consumer countries are China, Russia and U.A.E.

The trends, before the crisis, was few percent growth, as indicated by additional capacity at several converters, and progressive replacement of PE by FR compounds for core layer. Growth in architectural in Europe is anemic (as construction has already taken place) and growth between the first decade of the new century was triggered by Eastern Europe (e.g. Romania, Poland), Gulf region and Pacific Rim countries.
Of course, the crisis that started in 2008, had a severe negative effect in this industry, since more than 80% of the total production ended up in new buldings.

The architects nowadays are looking for novel colours and finishes, with impressive results in specific projects.

Picture 7: Berlin (renovation of old building)

FR Regulations:

The debate for fire properties and characteristics was always a key issue in the industry and was revived even more, with recent fires in buildings cladded with ACP, as in the case of Al Nasr Towers in 2007 in Qatar (cladded with Alutile) and commercial building in Bucharest in 2009 (cladded with Exalco-Bond). Fire is always regarded the most important element for building facades, due to the fatal implications that it might infer for the inhabitants of the building.

Picture 8: Fire in Al Nasr Towers, Doha, Qatar

We have to note some key issues:
- The correct terminology for the material FR, is Fire – Retardant (since it delays fire) and not Fire – Resistant (since no material used in composite panels has been discovered to have full tolerance to fire). The most widely recognized standards are E84 in US and DIN 4102 – B1 in Europe.

- It is a false impression that fire – retardant materials are measured in terms of minutes to be burnt. There are also other parameters that can be of equal importance, such as the toxicity of the fumes, spread of flames and droplets that fell.

- The fire regulations vary heavily between countries, and reflect national differences, civic codes, cultural sensitivities and historical events, and environmental factors.
In Germany (in Europe when someone talks of best practice, usually means German practice) the local test has been based on average time plus 15 minutes that fire-department needs to arrive at a building in flames in rush hour, and evacuate a typical 5-floor building from the inhabitants.
It is definitely problematic to transfer building codes and regulations from one country to another, since there arise significant dissimilarities. European civic environments are characterized by low buildings (4-5 floors) densely built next to each other, so the fire regulations have been designed to prevent fire mainly from outside the building, and have subsequently given emphasis to the facades. Emirate civic environment, on the other hand, is characterized by high-rise buildings, in relatively large distance from each other, and so we feel that more emphasis should be given to prevent fire mainly from inside the building. In this case, there should be given some importance to facades but we should also pay emphasis to barriers between the floors, as the fire can be transmitted easily from the space behind the cladding.

Picture 9: Bremen civic environment **Picture 10**: Dubai civic environment

- The ever-lasting pressure for lower prices leads to inferior level manufacturers, but also inferior product characteristics. In Far East, the aluminium skin thickness is seldom 0,5 mm (as per the industry standard) and polyethylene is always recycled, sometimes from irrelevant products such as used car rubbers or supermarket bags.

European Union Fire Regulations:

There are specificities that are defined by the building regulations of each country. The European norms are generally accepted by EU countries but they are applied in parallel with the national regulations, where they exist (as in the case of Poland, Czech Republic, Hungary etc.). The rule is that the national legislation and national standards prevail to the European legislation.

This conflict exist as there are not yet common established norms for ACP, as it is still considered as a novel material contrary to more traditional materials (such as bricks, cinder blocks or ceramics).
Also, it is worth noting that respective authorities have not yet concluded about the final requirements for CE marking, nor is expected to do so before 2011.

The most ambitious effort, so far, to integrate national standards across Europe was the establishment of Euro-code (or Euro-classifications).
For the ACP, Euro-classifications measure fire reaction, smoke developed and droplets fell, in a very strict and detailed test.
It is a laboratory test that simulates an internal angle of a building –which is, the most difficult case, as it overrides any positive deflective factors, such as wind-, there is a burner, at 45 Kw power and for 30 minutes, and then parameters are measured.

Germany:

Institute DIBT examines the properties of the material (chemical composition, of composite panel as well as of individual materials that consist it), mechanical properties, non-toxicity of materials, fire behaviour, stability and strength of the product installed. There is no established norm, but the material installed with the support system has to perform sufficiently towards specific wind loads.
All the above, along with technical information, test reports etc. are gathered up in a scientific committee.
The classification is as follows, according to DIN 4102:
A1 (highest category): is provided to materials such as steel, marble, firebricks etc.
A2: is provided to solid aluminium etc. The only ACM that has been awarded this classification is Alucobond A2. Such classification is necessary for buildings above 8 floors.
B1: for ACM it has been provided to Reynobond FR, Etalbond FR, Alpolic. Such classification is necessary for office buildings, public buildings, schools etc.
B2: for ACM it has been provided to most materials that use virgin PE. Such category is mainly used in small private buildings.

There are several parameters that are examined in the overall testing, but the main emphasis is given to fire resistance.
The actual test consists of a free hanging sample that is left for 15 minutes in a furnace, and the parameters that are measured is the temperature of the smoke, the flame spread and the surface of the sample that is left after the test. The fire is applied in 45 Kw power at temperatures that can reach 450-500^{o} C.

France:

A procedure that is similar to the German one is followed, but more emphasis in placed to the support attitudes of the material.

The classification M1 applies for all buildings until 18 meters height and after that height, it is necessary to install materials with M0 classification. However, the range of properties for achieving M1 classification is less strict than those required for B1 classifications on Germany and it is hard to find a clear correspondence between these tests.

Officially, no product is allowed to be used in buildings, unless it has previously been licensed from the national institutes, even if the product has been tested and certified according to EN norms (same regulation applies also in Germany).

U.K.

The main fire laboratory is Warrington Research Institute and various brands have been certified from this institute.

The main concern in U.K. (as in all Anglo-Saxon countries) is the outrageous insurances that apply in case of accidents, and the contractors are, logically, reluctant to undertake such risks.

The British authorities examine the material per se, but in much lower depth and detail, does not examine any support strength and stability while mechanical properties, chemical composition, paint characteristics, bending etc. are tested in British Board of Agreement own laboratories.

Poland

Institute ITB issues technical approval for all building materials. They accept EN in parallel with the established national standards. They test the suggested cassette sizes from the manufacturer and they test submitted samples for the static loads and then static analysis of the loads is performed along with the theoretical calculations of the loads.

Other criteria include mechanical properties, paint properties, corrosion resistance.

The institute also demands technical manual from the manufacturer for the recommended cassette sizes and support structures.

There is national standard for fire reaction and there is an open field test (contrary to other countries, where the test is in laboratory conditions).

The regulation is that until 18 meters height, materials of classification similar to B1 should be used, and A2 materials for above 18 meters. There is requirement for A2 even if the perimeter of the building neighbours with busy roads or schools.

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