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CONSTRUCTION AND DECORATION MATERIALS

APCOR
Portuguese Cork Association

INDEX

CORK IN CONSTRUCTION AND DECORATION

Cork is a versatile raw material, suited to a variety of forms of technological processing and different applications. As a result, there is a wide range of cork-based products available on the market. The largest segments include cork stoppers (of various types and for various purposes), granulates, composite agglomerate and pure expanded agglomerate. Cork can also be found in conjunction with other materials, opening up other business areas. Cork is a natural, recyclable and environmentally friendly product, which in recent years has caused it to catch the eye of architects and designers who believe in eco-design and sustainability.

PROPERTIES OF CORK IN CONSTRUCTION

Lightness | Cork is light, and floats on water. For thousand years, this was its most obvious and well-known characteristic. Since ancient times, cork has been used for fishing tackle.

Elasticity and Resilience | Cork's cell membranes are highly flexible, making it compressible and elastic. This means that it returns to its original shape after being subjected to pressure.

Impermeability | The presence of suberin (a complex mixture of fatty acids and heavy organic alcohol) makes cork impermeable to both liquids and gases. As a result, it does not rot, making it one of the best insulants.

Insulation and fire-retardant qualities | The value of cork is further enhanced by its low conductivity to heat, sound or vibrations. This is because the gaseous components contained in cork are enclosed in small impermeable compartments, isolated from each other by a moisture-resistant substance. In comparison to any other natural substance, this feature makes cork one of the best insulants, both thermal and acoustic. Cork is also a natural fire retardant: it burns without a flame and does not emit toxic gases during combustion.

Wear-resistant | Cork is extremely wear-resistant, and has a high friction coefficient. Thanks to its honeycomb structure, its resistance to impact or friction is greater than that of other hard surfaces.

Hypoallergenic properties | As cork does not absorb dust, it helps protect against allergies and does not pose a risk to asthma sufferers. It also possesses an inalterable constitution which guarantees efficiency.

COMPOSITE AGGLOMERATES

PRODUCTION PROCESS

Granulates

The cork used in the production of construction and decoration materials comes from the first and second bark stripped from the cork oak, which is not used for stoppers, and cork leftovers, shavings, pieces and waste from other industries. The cork is ground, with the granules taking on a range of sizes (usually above 0,25 mm and below 22,4 mm) and densities (usually 70-90kg/m3). The granules are obtained using a number of different types of mill, according to the material to be ground and the type of granulate required.
After grinding, the granules are normally cleaned, followed by drying using forced circulation of hot air by means of rotating driers, giving the granulate the required moisture content.

Composite Agglomerates

These granules are the raw material for agglomerates, which are created by means of a process of agglutination of granules with a specific, pre-determined size and density using pressure, heat and a binder, depending on the product and application required.

Following automatic or manual dosage, the mixing of the granules with the binders and, if used, other additional components, is achieved by means of a mechanical process - blade or helical mixers. The density resulting from this process will depend on the intended purpose. For example, agglomerates for decorative purposes commonly have densities of 200 to 350 kg/m3 and use fine to medium granule sizes; for floorings the density is 450 kg/m3 to 600 kg/m3, while for expansion joints (cork is used between rigid elements - such as concrete - as an acoustic and thermal insulant) medium calibre granules are used and density varies between 250 and 350 kg/m3.

This agglutination is achieved using synthetic polyurethane, phenolic and melamine resins or vegetable-based resins.

During the agglomeration stage, the granules may also be coloured with pigments, which can be of a number of different colours.

The granules and resins are then placed in moulds, usually made of metal and rectangular in shape - though for cork rolls cylindrical moulds are used -, after which the moulds are pressed. They are then placed in a heating chamber, which may be an oven (using temperatures between 110ºC and 150ºC for a period of 4 to 22 hours) or high-frequency systems which are either continuous (tunnels) or discontinuous (the moulds used are made of fibreglass and can be ready for handling in 3-4 minutes).

Next, the agglomerate is unmolded and subjected to cooling/stabilisation, resulting in an agglomerate block suitable for cutting into sheets.

The next stage is sanding, which allows fine-tuning of the thickness and texture of the cork sheet. The sheets are then cut into a rectangular or square shape and checked for size and squareness.

Cork rolls are cut by continuously turning a cylindrical block against a blade.

Another process worthy of note is the combination of granules, binders and agents of the desired size, which are then spread out on a conveyor belt and passed through a heated plate press at a temperature of 120-180ºC, resulting in a single sheet of the desired thickness.

Once these sheets are produced, the different types of decorative materials and coverings are created. These can be made using a single sheet, by overlaying several sheets of agglomerate or laminated natural cork, or by combining agglomerate with other materials such as wood. The sheets are glued together with the aid of rollers or presses. The completed sheets can be given a range of surface finishes: varnished, waxed, painted or coated with particles, such as PVC.

Finally, manual/visual selection/rejection takes place to eliminate any defects which may have occurred (such as broken corners, defective varnishing, etc).

The product is then packaged and stored.

MAIN USES

The main uses of these products are: floorings and wall coverings for homes, hospitals, offices and retail establishments, among others.

MAINTENANCE AND CLEANING

Cork floorings can be cleaned in a quick and regular fashion. Each supplier offers a special spray which is applied to the surface in sections, moistening it. The flooring should then be cleaned with a mop in a spiral motion and left to dry. For dirtier floors, suppliers recommend other products for more targeted application. The flooring must be cleaned in sections, using a scrubbing pad to remove the dirt, dissolving it in clean water before it dries again.

For less regular maintenance, suppliers recommend products to be applied to the flooring with a mop or short hair wax applicator. The product should be applied to clean, dry floors in a thin, uniform coating

using a wax applicator; work on a 1,5 m2 area at a time; leave to dry for 30 minutes (drying time varies according to humidity levels); wait until completely dry, to avoid working on a partially dried area.

OTHER COMPOSITE AGGLOMERATES

Composite agglomerate with rubber
This is a type of agglomerate which can take on various different compositions, produced by mixing and agglomerating cork granules with natural or synthetic rubber (as dust or small particles) and other agents (vulcanising, anti-oxidant, polymerisation accelerators, colourings, etc.). It is homogenised, compressed and heated in rotating cylindrical mixers. Finally, it is passed through rollers, giving rise to a homogeneous mass which is cut into sheets, moulded, pressed and cured, just like composite agglomerates incorporating synthetic or natural resins, resulting in blocks which are subsequently cut to the desired size. The density of the product varies from 250 to 950 Kg/m3. It is characterised by a combination of the compressibility, elasticity and resistance to oil and gas of cork with the flexibility, extensive compatibility with liquids, low distortion under pressure, anti-vibrational properties and resilience of rubber. One of the possible applications is for use in joints.

Corkgel
A composite comprising silicone and natural cork granules. It is used as tape on bicycle handlebars for its excellent characteristics: resistant to collisions and impact; comfortable; resistant to heat, water and sweat; elastic. This product is also used in shoe insoles.

Cork agglomerate veneer on wood, MDF, aluminium or other materials
This is a process which can be used with a wide variety of base materials such as sheets or panels of wood, MDF and aluminium, to which sheets of cork are glued and pressed. Tests have been carried out for a number of furniture applications.

PURE EXPANDED AGGLOMERATE

PRODUCTION PROCESS

Pure expanded agglomerate, also known as pure or black agglomerate, is made by means of the agglutination of virgin cork granules, mostly from the pruning of oak trees, with a higher concentration of extractives than other types of cork, which act as a natural adhesive.
The cork is submitted to a granulation process similar to that for composite agglomerates. The final granule size obtained depends on their intended use, from 3 to 10 mm for acoustic agglomerate and 5 to 22 mm for thermal agglomerate.
Next, impurities are removed, specifically wood and bark pocket, with the aid of densimetric separators and sometimes pneumatic separators or rotating drums. The granulate is stored and dried until the ideal moisture level is reached. The granules are then agglomerated using the autoclave process, which also serves as a mould. The cork is boiled by insufflation of superheated steam, at a temperature of 300-370ºC. The steam passes through the mass of granules, bringing about the exudation of cork resins to the surface of the granules, causing them to expand, and as a result of being in the autoclave they are agglutinated. Boiling time varies from 17 to 30 minutes, depending on the initial moisture content.
The result are cork blocks which are cut into sheets of varying thickness, normally using a bandsaw, after which they are adjusted for size and squareness using a circular saw. The blocks are packaged and stored.

MAIN USES

- Outer walls (cladding);
- Cavity walls;
- Level and sloping coverings;
- Floating paving (impact noise);
- Partitions;
- Insulation of doors;
- Prefabricated wooden houses;
- Thermal and acoustic wooden panels;
- Expansion joints (appropriate density);
- Visible outer facades.

CHARACTERISTICS

- Renewable and 100% natural raw material;
- Unlimited durability without losing its properties;
- Completely recyclable;
- Excellent dimensional stability (even when subject to wide thermal variation);
- Density: 110/120 kg/m3;
- Thermal conductivity coefficient 0.038/0.40 W/mk;
- Low energy consumption (93% cork, 7% electricity).

OTHER EXPANDED AGGLOMERATES

Regranulates
Produced using waste from expanded agglomerate, mainly used for filling walls, terraces and coverings, can be mixed with concrete.

Technical black agglomerate
This kind of agglomerate normally uses granules between 5 and 22 mm, has an average density of around 115kg/m3 and is used as a thermal insulating in civil construction for its thermal conductivity.

Vibratic agglomerate
Has a higher density, usually above 170kg/m3, and greater mechanical resistance than thermal black agglomerate. Its elasticity enables it to bear high loads and it is used as a vibratic insulant for machinery, construction foundations and joints.

Acoustic agglomerate
Uses granules between 5 and 10 mm in size and has a density of 95 kg/m3. Has a high capacity for acoustic absorption, reducing reverberation times. Used in civil construction and sound correction/reduction.

REFERENCE WORKS

- Coverings in the cells of Arrábida Convent in the mountain range of the same name, Santa Cruz Convent in the Sintra mountain range and Buçaco Convent in Coimbra, Portugal.
- Fallingwater, by Frank Lloyd Wright (bathroom walls), USA;

- Portugal Pavilion at Expo Hannover 2000 by Siza Vieira and Eduardo Souto Moura - outer walls partially covered with cork, currently located in Coimbra;
- Plano B and Arruda Wine House, outer walls covered with cork, Portugal;
- Cork Oak and Cork Observatory, by Manuel Couceiro, outer walls covered with cork, Coruche, Portugal;
- Flooring of the Adobe Photoshop Building in Seattle, USA;
- Cork House, by Arquitectos Anónimos®, outer walls covered with cork, Esposende, Portugal;
- Warehouse for ageing of Quinta do Portal, by Siza Vieira, outer walls covered with cork, Douro, Portugal;
- Eco-cabin, by Flavio Barbini and João Silva, constructed entirely of cork, Cascais, Portugal;
- Portugal Pavilion at Expo Shanghai 2010, by Carlos Couto, outer walls covered with expanded agglomerate and indoor flooring made of cork.
- Floor of the Sagrada Família Cathedral in Barcelona, Spain, by the architect Jordi Bonet i Armengol;
- Floor of the yacht Matrix, Vision 450, South Africa;
- Covering and Floor of Green House Hotel, Cape Town, South Africa, by M&B Architects&Interiors;
- Floor of Nezu Galeria 4 Museum, Tokyo, Japan;
- Floor of Aveda Frederic's Institute in Indianapolis, USA;
- Serpentine Gallery, London, UK, by the architects Herzog & de Meuron and the artist Ai Weiwei;
- Colégio Pedro Arrupe (school) by the architect Alves Ribeiro, outdoor covering of expanded agglomerated cork, Sacavém, Portugal;
- Floor of Inspira Santa Marta Hotel, Lisbon, Portugal;
- Floor of Microsoft Lisbon Experience, FOCUS group, architect Nuno Malheiro da Silva, Lisbon, Portugal;
- Villa Extramuros, Jordi Fornells, indoor and outdoor floors and coverings, Arraiolos, Portugal;
- Adega Logowines, Herdade da Pimenta, PMC Arquitectos, outdoor covering, Évora, Portugal;
- Exhibition Pavilion of Paços de Ferreira, exterior in expanded MD Fachada cork, Paços de Ferreira, Portugal;
- EcorkHotel, José Carlos Cruz, outdoor covering, located in the montado, Évora, Portugal;
- Penitenzieria (next to Turin Cathedral), Amorim Isolamentos/Be-eco, walls covered with expanded agglomerated cork, Turin, Italy;
- Brazilian Pavilion at Expo Milan 2015, Studio Arthur Casas/Atelier Marko Brajovic/ Studio Mosae/ Amorim Isolamentos, MD fachada, Milan, Italy;
- CBS – Cork Block Shelter, David Mares, total construction in cork, Vale dos Barris, Setúbal, Portugal;
- Quinta do Portal, Álvaro Siza Vieira, outdoor wall covered with cork and thermic and acoustic insulation, Douro, Portugal;
- Clérigos Tower Museum, João Pestana, semicircular capsule in cork for disable people multissensorial perception, Porto, Portugal;
- Bordeaux Contemporary Art Museum, Leonor Antunes, cork flooring Wicanders, Bordeaux, France;
- Somerset House – London Fashion Week, Tony Smith, cork flooring and columns covered by cork, London, United Kingdom;
- Auditorium of Ordem Arquitectos – Auditório Negócios Gyptec, Gyptec Ibérica/Amorim Isolamentos, expanded cork in the floor, walls and furniture, Lisbon, Portugal.

For further information see "Technical Manual of Construction and Decoration Materials" available at http://www.apcor.pt/en/portfolio-posts/information-about-cork-us-a-construction-and-bulding-material/.