Particle board

Particleboard, or particle board, (called "chipboard" in the UK and Australia) is an engineered wood product manufactured from wood particles, such as wood chips, sawmill shavings, or even saw dust, and a synthetic resin or other suitable binder, which is pressed and extruded. Particleboard is a type of fiberboard, a composite material, but it is made up of larger pieces of wood than medium-density fibreboard and hardboard.

A. Characteristics

Particleboard is cheaper, denser and more uniform than conventional wood and plywood and is substituted for them when appearance and strength are less important than cost. However, particleboard can be made more attractive by painting or the use of wood veneers that are glued onto surfaces that will be visible. Though it is denser than conventional wood, it is the lightest and weakest type of fiberboard, except for insulation board. Medium-density fibreboard and hardboard, also called high-density fiberboard, are stronger and denser than particleboard.

A major disadvantage of particleboard is that it is very prone to expansion and discoloration due to moisture, particularly when it is not covered with paint or another sealer. Therefore, it is rarely used outdoors or places that have high levels of moisture, with the exception of some bathrooms, kitchens and laundries, where it is commonly used as an underlayment beneath a continuous sheet of vinyl floor covering. In such an installation the edges must be properly covered upward against the wall and joints and non-covered edges must be properly sealed against moisture penetration. A higher quality material not subject to expansion is underlayment-grade plywood, which is constructed without interior voids in its layers to better resist the high local pressure from objects such as stiletto heels.

B. History and development
Modern plywood, as an alternative to natural wood, was invented in the 19th century, but by the end of the 1940s there was not enough lumber around to manufacture plywood affordably. Particleboard was intended to be a replacement. The first commercial piece was produced during World War II at a factory in Bremen, Germany. It used waste material such as planer shavings, offcuts or sawdust, hammer-milled into chips, and bound together with a phenolic resin. Hammer-milling involves smashing material into smaller and smaller pieces until they pass out through a screen. Most other early particleboard manufacturers used similar processes, though often with slightly different resins.

It was found that better strength, appearance and resin economy could be achieved by using more uniform, manufactured chips. Manufacturers began processing solid birch, beech, alder, pine and spruce into consistent chips and flakes. These finer layers were then placed on the outsides of the board, with the central section composed of coarser, cheaper chips. This type of board is known as three-layer particleboard.

More recently, graded density particleboard has also evolved. It contains particles that gradually become smaller as they get closer to the surface.

### C. Manufacturing

Manufacturing Process

Particleboard is a form of fiberboard. Other fiberboards include medium density fiberboard (MDF) and hardboard. Particleboard is the least dense of these and,
therefore, the least strong. Other forms of wood sheet products include plywood, which is constructed by gluing together thin sheets of wood (veneer).

Particleboard is manufactured by mixing wood particles or flakes together with a resin and forming the mix into a sheet. The raw material to be used for the particles is fed into a disc chipper with between four and sixteen radially arranged blades. The particles are first dried, after which any oversized or undersized particles are screened out.

Resin, in liquid form, is then sprayed through nozzles onto the particles. There are several types of resins that are commonly used. Urea formaldehyde resin is the cheapest and easiest to use. It is used for most non-water resistant boards. Melamine formaldehyde resin is significantly more expensive, as it is moisture resistant. Phenol formaldehyde is also fairly expensive. It is dark colored and highly durable. These resins are sometimes mixed with other additives before being applied to the particles, in order to make the final product waterproof, fireproof, insect proof, or to give it some other quality.

Once the resin has been mixed with the particles, the liquid mixture is made into a sheet. A weighing device notes the weight of flakes, and they are distributed into position by rotating rakes. In graded density particleboard, the flakes are spread by an air jet which throws finer particles further than coarse ones. Two such jets, reversed, allow the particles to build up from fine to coarse and back to fine.

The sheets formed are then cold-compressed to reduce their thickness and make them easier to transport. Later, they are compressed again, under pressures between two and three megapascals and temperatures between 140 °C and 220 °C. This process sets and hardens the glue. All aspects of this entire process must be carefully controlled to ensure the correct size, density and consistency of the board.

The boards are then cooled, trimmed and sanded. They can then be sold untreated, or covered in a wood veneer.

**D. Impact on timber resources and the environment**

Particleboard and other manufactured boards have had a very positive impact on timber resources, stemming almost entirely from the use of recycled materials. Seventy-five percent of particleboard manufactured in Canada and the US is constructed entirely from recycled materials. The remaining twenty-five percent of boards are constructed partially from recycled material and partially from virgin wood. These mixed panels have an average recycled content of sixty-six percent. This is still significantly more resource efficient than solid wood, even
when considering that in many cases these panels will be covered with a thin veneer of virgin wood.

Europe consumes around 45 million cubic metres of particleboard and MDF every year. If solid wood were used instead of these manufactured boards, an enormous burden would be placed on the environment. It lessens the need for trees to be felled, while at the same time reducing waste.

**E. Furniture design**

Particleboard has had an enormous influence on furniture design. In the early 1950s, particleboard kitchens started to come into use in furniture construction but, in many cases, it remained more expensive than solid wood. A particleboard kitchen was only available to the very wealthy. Once the technology was more developed, particleboard became cheaper.

Large companies such as Freedom and Ikea base their strategies around providing well-designed furniture, at a low price. In almost all cases, this means particleboard. Ikea’s stated mission is to “create well-designed home furniture at prices so low as many people as possible will be able to afford them”. They do this by using the cheapest materials possible, as do most other major furniture providers. As a result, solid wood furniture has become an expensive luxury and particleboard the norm.

**F. Safety**

Safety concerns arise from the glue that is used to glue the particles together in the production, and some people believe that the dust produced is toxic. [citation needed] In most boards, this resin is formaldehyde based. Formaldehyde is classified by the WHO as a human carcinogen.[1] 99.99% of this chemical is contained within the board by the curing process. However, when using power tools on the boards, much more is released in wood dust, which must be removed. This is done by dust extraction, with extractors running at least ten to twenty metres per second capture velocity.

**G. Comparison of solid wood to particleboard**

Particleboard’s selling point is its price. However, it has several other advantages, one of which is its stability. Solid wood is prone to warping and splitting with changes in humidity, whereas particleboard is not. This stability enables new design possibilities, without having to take into account seasonal variations. Untreated particleboard will disintegrate, however, when exposed to high levels of moisture. This problem is somewhat mitigated by laminating the particle board on both sides with melamine resin to reduce moisture ingress.
Solid wood has structural advantages over particleboard. It is stronger, allowing it to support greater weights as shelves or other furniture; unless braced or built with thick material, particleboard shelves may visibly sag over time. Solid wood is also more durable. Most damage to solid wood can be repaired easily, often simply by sanding. Any damage to particleboard is difficult to repair.

Many people consider solid wood furniture to be more attractive than particleboard. However, the veneer on particleboard is usually cut from wood selected for its appearance and so has the potential of being just as attractive.