INDUSTRIAL PROCESS

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SESSION 6 PHYSICAL CHANGE

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Physical change

Industrial processes are procedures involving chemical, physical, electrical or mechanical steps to aid in the manufacture of an item or items, usually carried out on a very large scale. Industrial processes are the key components of heavy industry.

Physical changes are changes affecting the form of a chemical substance, but not its chemical composition. Physical changes are used to separate mixtures into their component compounds, but can not usually be used to separate compounds into chemical elements or simpler compounds.[1]

Physical changes occur when objects or substances undergo a change that does not change their chemical composition. This contrasts with the concept of chemical change in which the composition of a substance changes or one or more substances combine or break up to form new substances. In general a physical change is reversible using physical means. For example salt dissolved in water can be recovered by allowing the water to evaporate.

A physical change involves a change in physical properties. Examples of physical properties include melting, transition to a gas, change of strength, change of durability, changes to crystal form, textural change, shape, size, color, volume and density.

An example of a physical change is the process of tempering steel to form a knife blade. A steel blank is repeatedly heated and hammered which changes the hardness of the steel, its flexibility and its ability to maintain a sharp edge.

Many physical changes also involve the rearrangement of atoms most noticeably in the formation of crystals. Many chemical changes are irreversible, and many physical changes are reversible, but reversibility is not a certain criterion for classification. Although chemical changes may be recognized by an indication such as odor, color change, or production of a gas, every one of these indicators can result from physical change.

Examples

Heating and cooling

Many elements and some compounds change from solids to liquids and from liquids to gases when heated and the reverse when cooled. Some substances such as iodine and carbon dioxide go directly from solid to gas in a process called sublimation.

Magnetism

Ferro-magnetic materials can become magnetic. The process is reversible and does not affect the chemical composition.

Crystalisation

Many elements and compounds form crystals. Some such as carbon can form several different forms including diamond, graphite, graphene and fullerenes including buckminsterfullerene.

Crystals in metals have a major effect of the physical properties of the metal including strength and ductility. Crystal type, shape and size can be altered by physical hammering, rolling and by heat

Mixtures

Mixtures of substances that are not soluble are usually readily separated by physical sieving or settlement. However mixtures can have different properties from the individual components. One familiar example is the mixture of fine sand with water used to make sandcastles. Neither the sand on its own nor the water on its own will make a sand-castle but by using physical properties of surface tension, the mixture behaves in a different way.

Solutions

Most solutions of salts and some compounds such as sugars can be separated by evaporation. Others such as mixtures or volatile liquids such as low molecular weight alcohols, can be separated by fractional distillation.

Alloys

The mixing of different metal elements is known as alloying. Brass is an alloy of copper and zinc. Separating individual metals from an alloy can be difficult and may require chemical processing – making an alloy is an example of a physical change that cannot readily be undone by physical means. Alloys where mercury is one of the metals can be separated physically by melting the alloy and boiling the mercury off as a vapour.

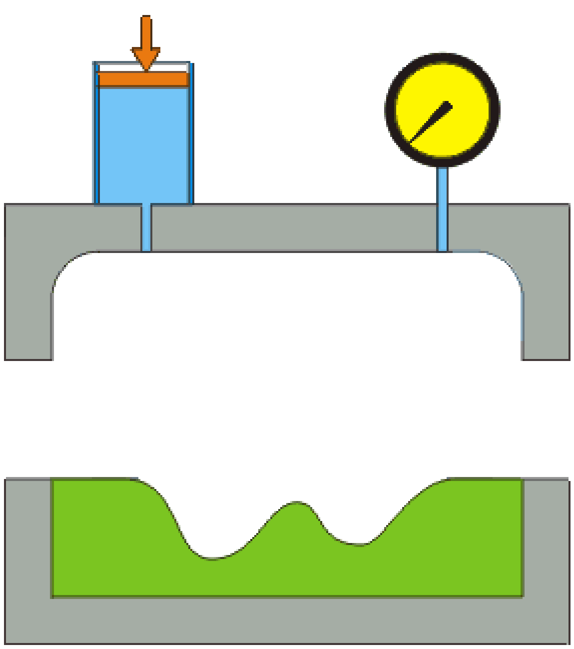
cal processes[

There are several physical processes for reshaping a material by cutting, folding, joining or polishing, developed on a large scale from workshop techniques.

See also: Fabrication (metal)

- Forging - the shaping of metal by use of heat and hammer
- Casting - shaping of a liquid material by pouring it into moulds and letting it solidify
- Progressive stamping - the production of components from a strip or roll
- Stamping
- Hydroforming - a tube of metal is expanded into a mould under pressure
- Sandblasting - cleaning of a surface using sand or other particles
- Soldering, Brazing, Welding - a process for joining metals
- Tumble polishing - for polishing
- Precipitation hardening - heat treatment used to strengthen malleable materials
- Work hardening - adding strength to metals, alloys, etc.
- Case hardening, Differential hardening, Shot peening - creating a wear resistant surface
- Die cutting - A "forme" or "die" is pressed onto a flat material in order to cut, score, punch and otherwise shape the material

Hydroforming



Hydroforming is a cost-effective way of shaping ductile metals such as aluminum, brass, low alloy steels, stainless steel into lightweight, structurally stiff and strong pieces. One of the largest applications of hydroforming is the automotive industry, which makes use of the complex shapes possible by hydroforming to produce stronger, lighter, and more rigid unibody structures for vehicles. This technique is particularly popular with the high-end sports car industry and is also frequently employed in the shaping of aluminium tubes for bicycle frames. Hydroforming is a specialized type of die forming that uses a high pressure hydraulic fluid to press room temperature working material into a die. To hydroform aluminum into a vehicle's frame rail, a hollow tube of aluminum is placed inside a negative mold that has the shape of the desired result. High pressure hydraulic pumps then inject fluid at very high pressure inside the aluminum tube which causes it to expand until it matches the mold. The hydroformed aluminum is then removed from the mold. Hydroforming allows complex shapes with concavities to be formed, which would be difficult or impossible with standard solid die stamping. Hydroformed parts can often be made with a higher stiffness-to-weight ratio and at a lower per unit cost than traditional stamped or stamped and welded parts. Virtually all metals capable of cold forming can be hydroformed, including aluminum, brass, carbon and stainless steel, copper, and high strength alloys.[

Tumble finishing

Tumble finishing, also known as **tumbling** or **rumbling**,[1] is a technique for smoothing and polishing a rough surface on relatively small parts. In the field of metalworking, a similar process called **barreling**, or **barrel finishing**,[2] works upon the same principles.

Stone

Tumbled gemstones. (Note that four of the items in the picture are not tumbled)

For tumbling of rocks as a lapidary technique, a plastic or rubber-lined barrel is loaded with a consignment of rocks, all of similar or the same hardness, some abrasive grit, and a liquid lubricant. Silicon carbide grit is commonly used, and water is a universal lubricant. The barrel is then placed upon slowly rotating rails so that it rotates. The optimal speed of rotation depends on the size of the tumbler barrel and materials involved.

A well-chosen speed for stone polishing causes the rocks within the barrel to slide past each other, with the abrasive grit between them. The result of this depends on the coarseness of the abrasive, and the duration of the tumble.


A typical rock tumbler

Typically, a full tumble polish from rough rock to polish takes between 3–5 weeks, and is done in a minimum of 3 steps. Initially, the rocks are smoothed with a coarse grit (such as 60-90 mesh). This is followed by washing and then a stage of finer grits (120-220 then 400-600 mesh), before the (optional) use of a pre-polishing compound (1200 grit), a washing cycle with detergent to remove any grit on the stones. The final step is a polishing stage using powdered polish, (such as cerium oxide or tin oxide), water, and often small plastic pellets that are designed to cushion the stones as they tumble (so as not to cause chipping) and carry the polish evenly across the stones. The precise tumbling time is determined by many factors, including the hardness of the rock and the degree of smoothing desired in the coarser steps. Some people will tumble stones with rough grit for two, three or even four weeks to get their desired shapes out of the stones.

Sometimes, stone "preforms" are used. This refers to cutting shapes from the rough rock, before tumbling. This gives more control over the final piece, so shapes such as a tear drop can be produced. The technique is still limited to rounded shapes. Preforms may use less time with the coarsest step, or skip it altogether.

During the 1970s, small rock tumblers were a common hobby item, and jewelry decorated with tumbled semi-precious stones was very much in fashion. Likewise, dishes and decorative glass jars filled with tumbled stones (often including common rocks not suitable even for costume jewelry) were frequently used as household ornaments.

Metal

See also: Mass finishing

Metal tumbling is used to burnish, deburr, clean, radius, de-flash, descale, remove rust, polish, brighten, surface harden, prepare parts for further finishing, and break off die cast runners.[citation needed] The process is fairly simple: a horizontal barrel is filled with the parts which is then rotated. Variations of this process usually include media, water, or other lubricants. As the barrel is rotated the material rises until gravity causes the uppermost layer to landslide down to the other side. The barrel may also have vanes, typically made of rubber, which run along the inside of the barrel.[citation needed] As the barrel turns the vanes catch and lift the parts, which eventually slide down or fall.[2]

In a wet processes a compound, lubricant, or barreling soap is added to aid the finishing process, prevent rusting, and to clean parts. A wide variety of media is available to achieve the desired finished product. Common media materials include: sand, granite chips, slag, steel, ceramics, and synthetics. Moreover, these materials are available in a wide variety of shapes. Usually different shapes are used in the same load to reach into every geometry of the part.

Tumbling is an economical finishing process because large batches of parts can be run with little or no supervision by the operator. A full cycle can take anywhere from 6 to 24 hours with the barrel turning at 20 to 38 RPM.[citation needed] Tumbling is usually most efficient with the barrel half full.[citation needed] Some processes also use a filter system to allow parts or other materials in the cylinder to be separated.

The disadvantages of this process are that the abrasive action cannot be limited to only certain areas of the part, cycle times are long, and the process is noisy.[3]

Specific types

Barrel burnishing is a type of barreling where no cutting action is desired. The goal is to reduce minute irregularities and produce a clean, smooth surface. The parts are usually tumbled against themselves or with steel balls, shot, rounded-end pins, or ballcones to achieve this. It is also usually a wet process that uses water and a lubricant or cleaning agent, such as soap or cream of tartar. The barrel is not loaded more than half full and if media is used then a 2:1 ratio of media to parts is maintained to keep the parts from rubbing.[3]

Centrifugal barrel tumbling uses a tumbling barrel at the end of a rotating arm to add centrifugal forces to the barreling process. This can accelerate the process 25 to 50 times.[3]

Spindle finishing mounts the workpieces onto spindles that rotate the parts opposite that of the media flow. This prevents the parts from interacting with each other and accelerates the cycle time, but extra time and cost are required to fixture the workpieces.[4]

Glass[

Stained glass shards used for mosaic glass are also tumbled. No abrasive is used, to avoid clouding the glass; there is only water as a lubricant. The object of this tumbling is to remove the sharp edges from the glass, so that it may be handled safely. As little as 8 hours of tumbling may be sufficient for tumbled glass.

defining physical processes

Atmosphere

The gases surrounding Earth

Biosphere

The parts of the earth with life

Erosion

the weathering of earths surfaces

Hydrosphere

The layer of earth with water

Lithosphere

The solid rock portion of earth

Physical features

Something on earth that you can see

Soil budding

The process where soil is added to a landform

Tectonic features

The collision and separation of tectonic plates

Weathering

The erosion of Earth's surface