A glossary of agglomeration terms

With such a wide range of agglomeration methods and accompanying terms, conversations between suppliers and end users can quickly get confusing. Many terms are confusingly similar to one another and a mistake could lead to equipment that isn’t suitable for your application. To make sure we’re all speaking the same language when it comes to agglomeration, let’s revisit one of my previous articles and define a wide range of agglomeration terms.

General terms

Agglomerate. (Noun form.) The product of size enlargement, such as a pellet, ball, granule, or briquette.

Agglomeration. Size enlargement; the process of gathering fine particles into permanent larger shapes in which individual particles can still be distinguished.

Binder. An additive to the material being agglomerated that provides bonding strength in the final product. A binder can be a liquid or solid that forms a bridge, film, or matrix filler or that causes a chemical reaction.

Bonding. The forces of cohesion between particles, as in agglomerate bonding or bonding strength. See Strength.

Capping. The rupturing and breaking of a tablet (formed by a tabletting press) due to internal stress and imperfect particle packing.

Clustering. Loose bonding of particles by pendular and funicular bridges in the presence of moisture.

Clamshelling. Splitting of an imperfect, poorly formed briquette.

Coalescence. Growing or joining together into one form or group.

Coldbonding. A hydrothermal process performed at ambient or low temperatures that uses the cementitious characteristics of a binder (such as lime, silica, or magnesia) to induce a high-strength bond in pellets or briquettes. Often used with ore fines, steel mill waste, and coal.

Density. The mass per unit volume of a material under specified conditions of pressure. Also called apparent density, bulk density, or true density.

Porosity. The property of containing pores; the total volume of pores in a solid.

Strength. The power to resist force, strain, or stress.

Agglomeration methods

Agitation. Particle size enlargement without the use of pressure, either by tumbling, coalescence, or particle growth. Also called agitative agglomeration or tumble agglomeration.

Ammoniation-granulation. The formation of small fertilizer pellets from a mixture of minerals and chemicals in combination...
with a chemical reaction such as ammoniation.

**Balling.** The formation of spherical agglomerates (such as balls or pellets) with moisture. Applications include the formation of iron ore fines into greenballs.

**Briquetting.** Pressure agglomeration that forms shaped agglomerates called briquettes. Usually refers to double-roll press (or roller press) briquetting.

**Coating.** Applying a layer of material, a film, or a finish to a substrate. Applications include coated ceramics, medicinal tablets, fertilizers, and foods.

**Compaction.** Densification or compression of solids that firmly joins particles together.

**Compaction-granulation.** A type of briquetting where pressure is used to form a compacted sheet of material; the sheet is then milled (granulated) and screened to produce small agglomerates. Typically used for fertilizer production. Also called dry granulation.

**Conditioning.** The tumbling, mixing, and dedusting of fine material for dustless disposal or for feeding to a second processing stage.

**Dry granulation.** See Compaction-granulation.

**Encapsulation.** Enclosing powder or small granules in a protective membrane or capsule.

**Extrusion.** The formation of cylindrical agglomerates (such as pellets or extrudates) by forcing a plastic mass through a perforated die, then cutting the extruded material or allowing it to break off.

**Fluid-bed granulation.** See Spray granulation.

**Globulation.** Drop-formation of solutions, slurries, or melts. See **Prilling, Spray drying**, and **Spray granulation**.

**Granulation.** The formation of small granules by growth-tumble agglomeration.

**Growth-tumble agglomeration.** See Agitation.

**Heat bonding.** Using heat to fuse fine particles into solid shapes, as in sintering, calcining, or induration. Also called thermal agglomeration.

**Hot-melt granulation.** Pan granulation of concentrated hot melt, such as urea or ammonium nitrate.

**Induration.** In geology, the hardening of a mass or rock. In iron ore processing, heat-hardening iron ore pellets (taconite) on a grate, in a shaft, or in a rotary kiln. See Sintering.

**Instantizing.** The formation of loosely held agglomerates that have “instant” solubility in liquids. Applications include instant drink mixes, instant coffee, and instant milk.

**Isostatic pressing.** The compaction of powdered material into a predetermined shape by using a liquid or gaseous medium as the pressure-transmitting force.

**Micropelletizing.** The formation of small pellets — usually no larger than -6 mesh (3.3 millimeters) — by tumbling, growth agitation, or mixing. See Conditioning and Granulation.

**Mixer granulation.** Agitation and growth agglomeration in a mixer.

**Nodulizing.** The formation of irregular or spheroidal agglomerates by tumbling particles at elevated temperatures in a dryer or kiln.

**Pelletizing.** A form of the word pelleting used mainly in the compound animal feed industry to describe the extrusion of feed material into cylindrical pellets in a pellet mill or pellet press. See Pelletizing.

**Pelletizing.** The formation of pellets, balls, or granules by growth agitation and rolling of fines with moisture, generally in a rotating disc or drum pelletizer. The process usually refers to the green-pelletizing and drying of pellets, sometimes followed by firing, calcining, or induration.

**Prilling.** The formation of spherical agglomerates called prills from a melt by droplet dispersion in a chamber (prill tower) and free-fall cooling. Also called globulation or shotforming. Common applications include ammonium nitrate, urea, and sulfur.

**Roll pressing.** See Briquetting.

**Selective agglomeration.** The agglomeration of fine particles in liquid by adding a bridging agent during agitation. Also called immiscible liquid wetting, spherical agglomeration, and, particularly in coal preparation, oil agglomeration.

**Shotforming.** The agglomeration of a liquid into small balls or pellets; occurs in a spray tower where liquid falls through a cooling medium.

**Sintering.** High-temperature treatment of a mineral mixture (such as iron ore, carbon, and flux) by inducing a draft on a traveling grate device to form a hard clinker, called sinter cake. See Induration.

**Spheronization.** The rounding of moist, soft, cylindrical pellets in a spheronizer. Also called spherizing.

**Spray drying.** The formation of fine, granular solids or bead-like agglomerates by dispersing a liquid or semiliquid suspension or slurry in droplet form in a chamber in the presence of drying gases that evaporate moisture. Applications include food, pharmaceutical, and ceramic products.

**Spray granulation.** The formation of small, spherical agglomerates in a bed of spouted or circulating seed particles by spraying a solution, slurry, or melt into a chamber in the presence of drying air; can be batch or continuous. Applications include food products, chemicals, and minerals. Also called fluid-bed granulation.

**Tabling.** A punch-and-die procedure that compacts powdered or granular solids. Applications
include pharmaceuticals, food products, and chemicals.

**Tumble agglomeration.** See **Agitation.**

**Wet granulation.** Agitative agglomeration with moisture, used to form pellets or granules. Applications include fertilizer granulation in a rotating disc or drum pelletizer.

**Agglomeration equipment**

**Axial extruder.** An auger- or screw-type extruder where the extrusion die is at the end of an extrusion shaft and screw; shaft may be single or double.

**Basket extruder.** A low-pressure forming device with a basket-shaped perforated extrusion chamber and wiper blades.

**Blunger.** A vat or trough that contains a rotating shaft with knives, arms, or paddles for mixing clay and water into a slip. Used mainly in the ceramic and fertilizer industries. See **Pugmill.**

**Briquetter.** Usually refers to a double-roll press with pockets that shape fine materials (such as ore, coal, flue dust, or metal powders) into larger forms, sometimes with the use of a binder.

**Coating pan.** A bulb-shaped or conical mixing vessel that applies a material layer (or coating) on small granules, usually in the presence of a liquid, heat, or both. Typically used in the pharmaceutical and food industries.

**Countercurrent mixer-granulator.** A rotating mixing vessel, also used for granulation, that produces agitation using countercurrent rotating paddles, arms, or plows. Can be used for blending only or for forming pellets in the presence of moisture.

**Die.** A device for cutting, forming, or stamping material.

**Dome extruder.** An axial auger extruder with a dome-shaped die rather than a flat die.

**Drum granulator.** See **Pelletizer.**

**Exter press.** (German origin.) A piston extruder that forms brick-shaped briquettes in a channel. Used predominately in Europe for briquetting brown coal.

**Falling-curtain agglomerator.** (US origin.) Rotary drum with internal bar cage and spiral ribbon to create a constant-density falling curtain of material during liquid application and granulation. Sometimes called **O’Brien drum.**

**Gear briquetter.** A double-roll briquetter with two intermeshing gears; material is squeezed through the perforated inner part of the gears to form cylindrical briquettes.

**Marumerizer.** (Japanese origin.) Trade name for a spheronizing device.

**Muller.** Originally a device that used a stone or other hard tool to grind and mix drugs, paints, and similar materials. Today, the device is a blender with two large metal wheels that knead (mull) material; often used for preconditioning or binder-mixing prior to briquetting. Also called a **mix-muller.**

**Paddle mixer.** See **Pugmill.**

**Pan granulator.** See **Pelletizer.**

**Pellet mill.** An extrusion (pelletizing) device that consists of a rotating ring with perforations and rollers inside it. Used to extrude fines into cylindrical pellets. Typical applications include compound animal feeds.

**Pelletizer.** Usually describes a rotating disc, drum, or cone device that uses layering, particle growth, or agitation with the addition of water, binders, or both to form spherical pellets from fine dust and powder.

**Pin mixer.** A stationary-shell mixing and granulating machine with a single-shaft pin agitator for blending, preconditioning, granulating, and pelletizing.

**Piston press.** A mechanically or hydraulically actuated reciprocating piston that compacts dry or moist particles into brick- or puck-shaped pieces within a large cylindrical die. Also used for chips, borings, turnings, and other metallic particles. Also called a ram extruder or ram press.

**Plow mixer.** A mixing and granulating machine with a stationary chamber and agitator fitted with plowshare-shaped tools.

**Press.** Any device that applies pressure to a workpiece or material for the purpose of cutting, shaping, or forming under pressure. Typical agglomeration presses include the briquetter, extruder, tableting press, piston press, ram press, compactor, and punch-and-die press.

**Pugmill.** A paddle-type mixer, usually with double shafts, that has a trough-shaped chamber. Used for wetting, dedusting, cake forming, and granulation. Applications include clay, ceramic mix, flue dust, and mixed fertilizer.

**Punch and die.** Parts of a tool set that mold and form powders into compressed shapes, as in a piston press or tableting press.

**Radial extruder.** An extruder with a perforated screen in the circumference of the extrusion barrel; wiping blades and arms force the material through the screen die.

**Ram extruder or ram press.** See **Piston press.**

**Ring-die extruder.** A device that uses a rotating, perforated die press and rollers to force a wetted mass of particles through holes, where they’re cut into cylindrical pellets. Also called a **pellet mill.**

**Roll press.** Another name for a briquetter or double-roll briquetter. Also called a **roller press.**

**Schugi mixer.** (Dutch origin.) Trade name for a high-speed, vertical-shaft paddle mixer used to mix or agglomerate (or provide both to) powder and liquid.

**Zig-Zag blender.** (US origin.) Trade name for a continuous, multiple-cone blender that mixes or agglomerates.
Types of agglomerates

Bead. Any round object of wood, glass, metal, or ceramic.

Briquette. An agglomerate that consists of fine material pressed into the shape of a block, puck, cylinder, pillow, wafer, nugget, or log. The most common example is the commercial charcoal briquette. A derivation of the French term brique, meaning small brick. Also called briquet.

Densified refuse-derived fuel (dRDF). The briquetted or extruded lightweight, combustible portion of processed solid waste.

Granule. While pellet is typically used to describe mineral (such as iron ore) agglomerates, granule commonly describes chemical (such as fertilizer) agglomerates. See Pellet.

Greenball. Any moist, uncured pellet formed by agitative agglomeration, such as occurs in a rotating disc or drum pelletizer. Most frequently used in iron ore processing to distinguish the green, moist ball from the fired, indurated pellet.

Hot-briquetted iron (HBI). Briquetted metallic iron from direct reduction of iron ore fines or ferrous waste.

Nodule. In geology, a small hard mass or lump of mineral that is of contrasting composition and greater hardness than the surrounding sediment or rock matrix. In ore processing, a formed spherical or spheroidal agglomerate.

Pastille. Typically a small medicated or flavored tablet, usually formed by solidification of drop-forms on cooling belts.

Pellet. In mineral, iron ore, and coal processing, a spherical agglomerate; in compound animal feed and industrial catalyst processing, a cylindrical body; in pharmaceutical processing, a small pill.

Physical characteristics tests for agglomerates

Attrition (abrasion). Determines the resistance of an agglomerate to surface abrasion. Performed by subjecting an agglomerate to tumbling — in a rotating drum, laboratory tumbler, or laboratory sieve shaker — and measuring the percentage of abraded fines to provide an abrasion index. Abrasion media can be used to apply surface-attrition action.

Caking. Determines the tendency of agglomerates, like fertilizers or foods, to cake in containers or during bulk storage or transport. Measured by applying pressure to a mass of agglomerates during controlled cycles of time, temperature, and humidity.

Crush strength. Determines the agglomerate’s resistance to crushing and breaking during handling. Measured by crushing a pellet, briquette, or extrudate between plates and recording the total pound crush force required to break or crack the agglomerate.

Dispersibility. The ability of agglomerated solids to quickly and uniformly disperse in a liquid or solid (such as carbon black pellets dispersing in rubber compounding).

Homogeneity. Determines possible demixing of ingredients due to handling, storage, or the agglomeration process itself. Measured by comparing the homogeneity of a multicomponent material (such as fertilizer, glass batch, or sinter mix) before and after agglomeration.

Impact strength. Determines the maximum number of drops or impacts an agglomerate can survive before breaking or shattering. Can also be measured with a shatter test, where a weighed quantity of agglomerate is dropped en masse to simulate actual handling conditions.

Porosity. Determines the specific void volume of agglomerates. Used as a measure of densification — for example, to determine the relative porosity of pellets versus briquettes.

Product end use. Evaluates the performance characteristics of agglomerates in actual or simulated end uses. Examples include determining the combustion rate of coal pellets and briquettes; the melting rate of glass batch agglomerates; the grindability of fuel, carbon black, or mineral agglomerates; the reducing index of metal oxide agglomerates in furnaces; the pressability of micropellets in tablet and compacting presses; and the bulk factor of consumer goods (such as foods and detergents) in packaging.

Strength. Determines the ability of an agglomerate to withstand destructive force, as in crush strength or tensile strength. Measured by crushing, dropping, impacting, shearing, abrading, or tumbling the agglomerate. One model, developed by H. Rumpf, determines the tensile strength of agglomerates as a measure of strength and is defined as the tensile force at failure divided by the cross-section of the agglomerate. See Crush strength.

Weatherability. Determines the stability of an agglomerate during...
exposure to the elements, particularly during outside storage and transportation. For example, a waterproof index can be measured by immersing agglomerates in water for long periods, spraying them with water, or assessing their strength after rain or freeze-and-thaw cycles.

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