

Catalyst shaping and formulation

Mainly, solid catalysts are used in industrial catalytic processes and these are formulated in different forms such as pellets, extrudates, granules or sphere form.

Formulation and shaping of solid catalysts is done to :

- (a) avoid high pressure drop in fixed and moving beds
- (b) increase thermal resistance against sintering fracture or phase transition
- (c) increase mechanical resistance against crushing and attrition
- (d) ensuring high effective heat conductivity in fixed and moving bed for strongly exothermic and endothermic reactions

Aiming at highest catalyst efficiency is the primary objective in catalyst design because conversion, selectivity and thermal resistance are strongly affected by the above-mentioned parameters. Some of the common catalysts formulation techniques are :

- a. pellet formation
- b. granulation
- c. extrusion
- d. spray drying

Pellet formation :

It is a high pressure agglomeration technique producing particles of uniform shape and dimensions. Typically, the dry catalyst powders are compressed in a die by applying forces between 50-80 kN with a pressing tool. Factors such as ultimate tensile strength of the materials, moisture content, porosity, stickiness are important. Some materials, such as kieselguhr, undergo easy pellet formation whereas other materials such as alumina require addition of small amount of plasticizers or lubricants such as graphite, talc etc. Important processing parameters are the maximum applied pressure and the rate of pressure rise. Both influence the hardness of the pellets as well as the integrity of compacted particles.



Granulation :



This is a size enlargement process by wet tumbling. In this method, the particles are tumbled in a cylinder. A cohesive liquid is sprayed onto the catalyst powder such that the wetted particles stick together. The granules grow by contacting further particles. Product with wide size distribution can be produced by controlling parameters such as binders type and concentration, rpm of pan, granulation time and angle of inclination of pan. Typically, pan granulation yields spherical particles of diameters in the range of 2-20 mm.

Extrusion :

It is a widely used technique. In this method, a suspension or paste of the catalyst powder is passed through a profiled die that determines the shape of the body. Screw extruders are very common in use. Slurry of the catalyst is fed to the extrudate at one end and the screw forces the slurry through the holes at the other end. As the ribbon of slurry emerges from the holes, a knife is arranged at the end to cut it to the required size. Particles of narrow size distribution can be obtained by this method.

Spray drying :

This process involves atomization of slurry feedstock into a spray of droplets and contacting the droplets with hot air in a drying chamber. Particle sizes are determined by the size of droplets, which is controlled by design of spray nozzles, slurry flow rate, slurry viscosities. Products in a spray dryer are spheres of diameters in the range of 0.05 to 0.5 mm.



The schematic diagram of catalyst formulation techniques are shown in Fig. 2.

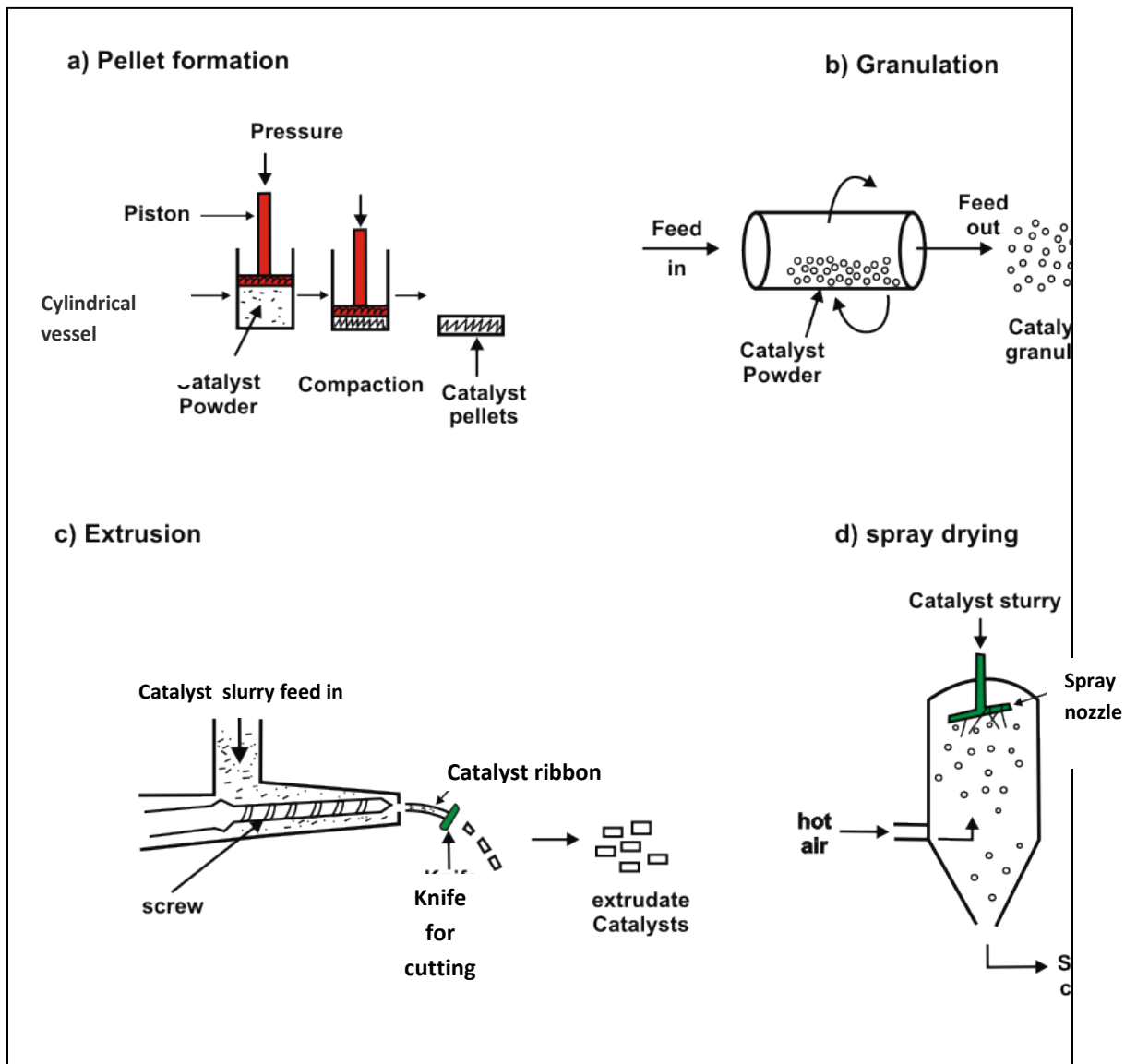


Fig. 2. Schematic diagram of different catalysts formulation techniques