PRESSURE VESSELS

In chemical processing industries two factors among others are outstanding, namely, the yield of the product and the speed at which the desired yield is attained. Among the conditions which will influence these factors, the most important are temperature and pressure. While the temperature range in which the desired yield may be obtained at reasonable speed is comparatively moderate, approx −100 to 4500°C, the pressure range is enormously wider in industrial applications. For example, in the synthesis of acetylene from light hydrocarbon vapors, a pressure of less than 1 atm is preferred, while in the manufacture of synthetic diamonds a pressure of about 100,000 atm is required. Between these two extremes, the chemical processing industries have been using various pressures such as those given in Table 1.

Table 1. Pressures Used in Industrial Applications

Application	Pressure,[a] atm	Application	Pressure,[a] atm
nitric acid	1–10	methanol synthesis	50–350
synthetic ethanol	65–70	hydrogenation of coal	350–600
hydrogenation of vegetable oil	20–350	acetic acid synthesis	650–700
hydrogenation of petroleum distillates	200–350	ammonia synthesis	200–1,000
urea synthesis	200–400	polyethylene	50–2,000
oxo process	250–300	synthetic diamond	100,000–110,000

[a] Note that 1 atm = 14.7 psia.

There is no agreed-on dividing line between high and low pressures, but some authorities in the chemical processing industry consider any pressure above 50 atm (about 750 psia) is in the high-pressure field.

High-pressure technology concerns mainly (a) the production and maintenance of the pressure (see Pumps and compressors), (b) the design of vessels and other components of the system, and (c) provision for resistance to corrosion in a manner that is more precise than the practice used in dealing with ordinary pressures.

See also Pressure measurement.

Design and Fabrication of Pressure Vessels

With the advent of large capacity chemical plants, operating at high pressure levels, the size of individual vessels and accessories also increased in size to previously unknown regions, and the question of safety became extremely important. Even with normal-size vessels, safety should always be a mandatory consideration in designing, fabricating, testing, and operating a high-pressure vessel.

In designing a high-pressure vessel, the procedure may run as follows: The first step is to decide the size and shape of the vessel as required by functions which the vessel is to perform. Then comes the choice of materials of construction which will resist the attack by substances with which the vessel will come in contact. Next, provisions for heat transfer and temperature control should be worked out based on thermodynamics. The safe thicknesses of the vessel wall and other parts and attachments should then be calculated based on stresses in the vessel wall and the strength of the materials selected. The method of fabrication may be chosen according to the costs involved, but equally important considerations are those concerning transpor-