FLUORINE - Handling, Storage, and Transport (Michel Jaccaud, Robert Faron, Didier Devilliers, René Romano)

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5. Handling, Storage, and Transport

Handling [28] , [68] , [69]. Because of the reactivity of elemental fluorine, special care must be taken in handling this gas. A passivation of the whole system (line and apparatus) with F_2 is imperative before each operation. Corrosion of passivated piping and valves is not a serious problem if moisture and reactive contaminants, such as grease, are kept out of the system. The whole system must be carefully tested for leaks; manipulations require a dry, ventilated room. The selection of materials to be in contact with fluorine depends on the expected temperature. Aluminum, copper, stainless steel, nickel, brass, Inconel, and Monel have been proposed for industrial use. Tables of corrosion data have been presented and reviewed in the literature [69]. For the handling of pure fluorine under pressure, the use of nickel or Monel pipes is preferable.

Fluorine is not difficult to handle near atmospheric pressures: in 1947, Cady claimed that the hazards of working with fluorine had previously been greatly over-rated. However, handling fluorine under high pressure is a different matter [29].

At moderate temperatures, reactions can be carried out, usually on a laboratory scale, in quartz, Pyrex, Teflon (polytetrafluoroethylene), or Kel'f (polymonochlorotrifluoroethylene). Metallic equipment is necessary for work at relatively high temperatures. A review of equipment that can be used in a laboratory was published recently [70].

Storage [71][72][73]. Storage only relates to a small percentage of the production. Electrolyzers are integrated in SF_6 or UF_6 units, and the major part of the elemental fluorine produced is directly used in the plant. In order to avoid the handling of bottled fluorine, ICI supplied 10-A and 60-A laboratory-scale cells to universities and to industry for many years [29]. At present, the use of reliable cylinders of compressed fluorine is preferred.

Compression and Liquefaction. Fluorine requires purification before liquefaction. HF must be removed to prevent icing; this is accomplished by a combination of refrigeration and NaF absorption traps [72]. Heating fluorine to 300 – 400 °C before liquefaction is useful for destroying traces of impurities such as oxygen fluorides; if they are not removed, these compounds spontaneously explode when the liquid phase is warmed for evaporation.

The compression of pure fluorine with ordinary compressors is difficult because lubricants react with the gas. Compressors of the diaphragm type have been used successfully for low-pressure storage, but for higher pressures the method used involves liquefaction of F_2 by cooling with liquid nitrogen and later re-evaporation of the gas to the desired pressure in the shipping container.

Transport. The French specification for the transport of fluorine is available from the "Imprimerie Nationale, Paris":

- Transport by rail and road (April 25, 1945, and June 27, 1951)
- Transport by air (January 14, 1983).

The European specification for transport by road (A.D.R.) is available from the United Nations (Geneva), and the specification for transport by rail (R.I.D.) can be obtained from the S.N.C.F. (Paris).

Fluorine must be packaged under a pressure not exceeding 2.86 MPa (28 bars); the steel cylinders, previously tested at 200 bars, must be equipped with special valves and must not contain more than 5 kg of elemental fluorine. They must be labeled with the toxic-product label number 6 – 1. Cylinders containing 2.2 kg and special packages of ten cylinders are available from COMURHEX.

In the United States, fluorine is supplied by Air Products and Chemicals as a mixture of 10 % F_2 in nitrogen. Liquid F_2 was available in the 1960 s in tank trucks containing up to 2270 kg of fluorine. The inner steel shell of the tank contained the liquefied product, the intermediate stainless steel shell was filled with liquid nitrogen, and the outer shell was filled with an insulating powder.

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