superheated steam at the lower end of the dehydration section of the reactor.

The dehydration reaction which takes place may be shown as:

$$UO_3.\ 2H_2O + HEAT \longrightarrow UO_3 + 2H_2O$$

Passing further down the column the dehydrated pellets are raised in temperature by the heating jackets surrounding the reactor and by the hot gases coming from below. At a temperature range between 1000 and 1250°F. the orange oxide is converted to brown oxide by the hydrogen in the reducing gas according to the following reaction:

$$UO_3 + H_2 \longrightarrow UO_2 + H_2O$$

This UO_2 is the final product of this stage of the process and the pellets which were a bright yellow on entering the reactor leave it dark brown in colour.

Because pure hydrogen gas is expensive to purchase or to manufacture, dissociated ammonia is used in its place and gives equally good results. Dissociated ammonia which is essentially a mixture of 75% by volume of hydrogen and 25% by volume of nitrogen is made by passing bottled anhydrous ammonia over a catalyst at an elevated temperature. The following reaction takes place:

$$2\ NH_3 + CATALYST \longrightarrow N_2 + 3\ H_2$$

While nitrogen is traditionally considered as the typical inert gas, economies also result by using instead a mixture of nitrogen and carbon dioxide for sealing purposes. This mixture of nitrogen and carbon dioxide is produced by burning natural gas in a special burner with a slight deficiency of air.

It might be further mentioned that this inert gas is also used both in this reactor and in the hydrofluorination reactor described below as a cooling gas. Coils are provided for sparging in the gas at various points in the reactors. When the temperature rises above a desirable level the gas can be admitted through these coils effectively reducing the temperature in the reactor.

Hydrofluorination

In a second moving bed reactor the brown oxide produced as described above is converted to uranium tetrafluoride or green salt. The equivalent in which this is done is essentially the same as the moving bed reactor used to produce UO_2. In this case, however, the feed to the reactor is the brown oxide pellets produced in the first reactor and the reactant gas is hydrofluoric acid gas (HF) rather than dissociated ammonia. The product produced, uranium tetrafluoride is a bright green in colour.

The reaction is as follows:

$$UO_2 + 4HF \longrightarrow UF_4 + 2\ H_2O$$

This reaction does not proceed as smoothly as the hydrogen reduction operation and extremely close control must be maintained on all operating conditions and particularly on the temperature profile along the length of the reactor. If the temperature is not controlled within very narrow limits off specification products can result or the reactor can become plugged or blocked because of overheating.

With good control production of a product showing a conversion of over 97% to UF_4 can be consistently maintained.

Because HF gas is an extremely corrosive and therefore a dangerous chemical, special precautions must be taken in handling and special provisions must be made in the equipment in which it is to be used. The off gases from the hydrofluorination reactor are therefore passed through a wet scrubber to remove any unreached HF gas before these gases are vented to the atmosphere. The dissolved HF in the scrubber water is then neutralized with ammonia.