

2020
MAY

०६ ज्येष्ठ कृष्ण, बुधवार, सं० २०७७

Dr. Sanjay Kumar Yadav

Lecture Notes Series: - 1

Chemistry of Fluorine

Introduction

Fluorine is the first element of group VII in periodic table. It is a member of the halogen family. Due to its extremely reactive nature, does not found free in nature. In combined state, it is fairly and widely distributed. It constitutes nearly 0.08% of lithosphere, it occurs in fluorospar (CaF_2), cryolite ($AlF_3 \cdot 3NaF$) and apatite [$CaF_2 \cdot 3Ca_3(PO_4)_2$]. In small quantities, it occurs in some of the micas. Traces of fluorine occurs in sea water, some mineral springs, bones, teeth, blood, milk, plants etc. As a matter of fact small quantities of fluorides present in soil find their way into river water, sea and plants and plants into bones, blood, and teeth of animals and human being.

Preparation

Isolation of fluorine presented a tough problem to chemists for about a century. All the difficulties inherent in its production arose from its extraordinary reactivity, it attacks water giving oxygen so that its production



by electrolysis
of aqueous solution of fluorides

was negated, it attacked glass, carbon, and almost all metals including platinum and hence the apparatus could not be made of these materials. The problem was however, finally solved by Moissan in 1886, who prepared fluorine by $[KHF_2]$ in anhydrous hydrogen fluoride using an apparatus made of platinum-iridium alloy using electrodes also of the same alloy.

In latter years, Moissan found that platinum-iridium alloy could be safely replaced by copper. This metal, though attacked by fluorine, gets covered with a thin impervious layer of copper fluoride which resists further attack.

For laboratory preparation of fluorine, Dennie veeder and Rochow electrolysed perfectly dry potassium hydrogen fluoride in a heavy V-shaped tube (about 5 cm in diameter) made of copper, using graphite electrode. The end of the tube are closed by copper caps through which pass the graphite electrodes. The latter are sealed and insulated by bakelite cement which is found to resist the attack of fluorine. The tube is heated in an electric resistance furnace to fuse the potassium hydrogen fluoride. For electrolysis, a current of 5 amperes at 12 volts is passed. The fluorine liberated at the anode is passed through copper U-tube containing

2020
MAY

ज्येष्ठ कृष्ण, शुक्रवार, सं २०७७

Sodium fluoride

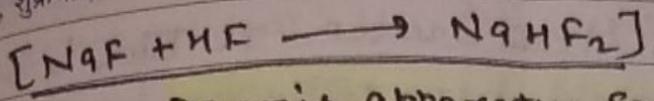
136-230 I

WK-20

FRIDAY

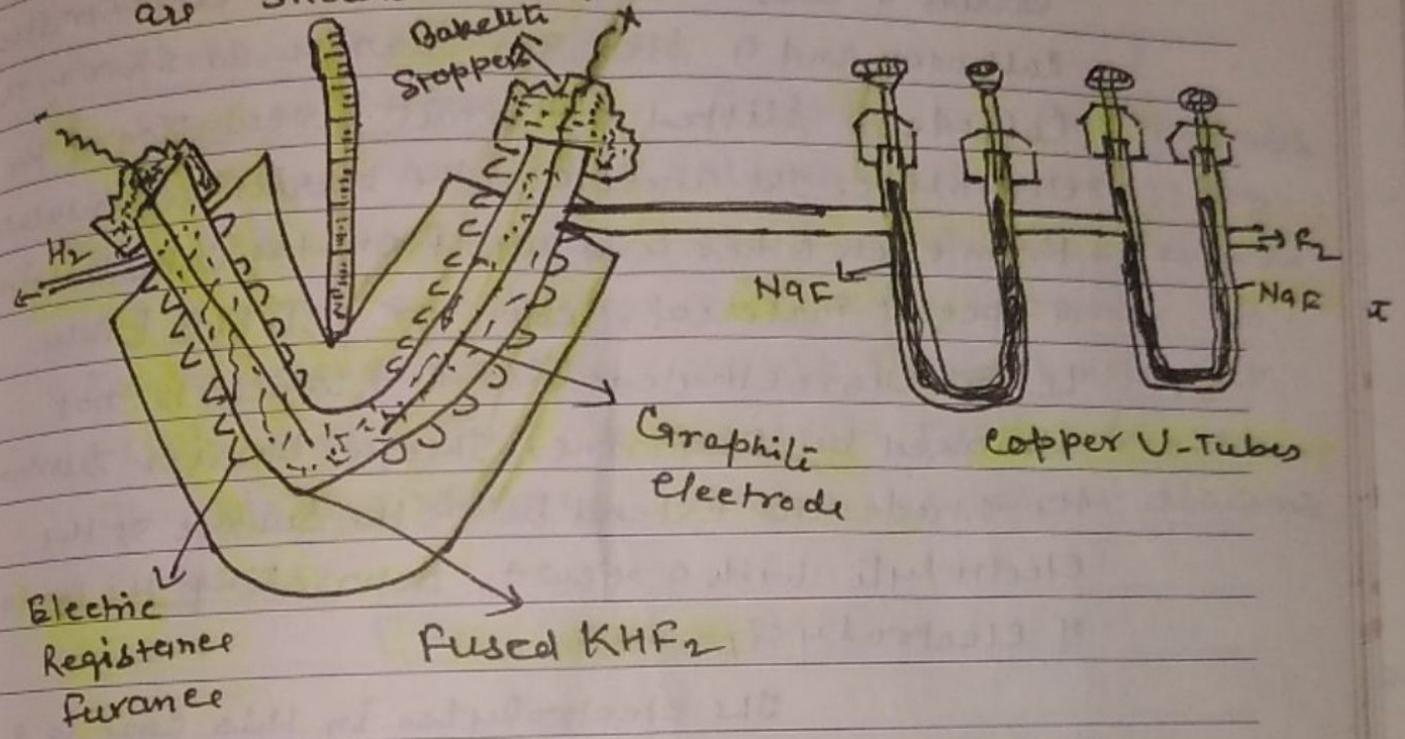
15

to free it from hydrogen fluoride.



Dennis apparatus for the preparation of fluorine

as shown below.



Commercial Preparation of Fluorine

Now a days even the commercial preparation of fluorine is no problem. Fluorine gas stored in steel tanks under pressure is offered for sale in America and other countries.

The essentials of the electrolytic cell used for the industrial preparation of fluorine. Its figure is shown below.



S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						

Modern method for the manufacture of fluorine.



Consist of a rectangular steel tank^{११} ज्येष्ठ कृष्ण, शनिवार, सं. २०/११
surrounded by a steam jacket. The tank is fitted with air-tight removable cover rounded which carries a carbon anode, two slitted copper or steel cathodes and a steel gas barrier as shown. The cathode is slitted to permit circulation of the electrolyte. The anode and the barrier are insulated from each other and also from the cathode with a special material, teflon or P.T.F.E [Poly. tetrafluoroethylene (C_2F_4)]_n which is not attacked by fluorine. The gas barrier surrounds the anode and extend below the surface of the electrolyte with a view to separating the products of electrolysis.

The electrolytes in this case is a 90% soln of KHF_2 in anhydrous hydrogen fluoride. This is kept in the molten state by heating it to about $95^\circ C$ with the help of steam passing through the steam jacket. But once the electrolysis start heating is no longer necessary because sufficient heat is produced during the process of electrolysis itself. On the other hand, cooling may sometimes be needed to maintain the electrolytes at about $95^\circ C$. The loss of hydrogen fluoride from the electrolyte is made good by passing in hydrogen fluoride periodically.

The fluorine obtained in this process

The moment there is suspicion about a person's motives, everything he does becomes tainted.
is almost pure and is compressed

into steel

११ ज्यैष्ठ कृष्ण, सोमवार, सं० २०७७

Cylinders at a pressure of about 26 atm if required, the small contamination of hydrogen fluoride is removed as usual by passing the gas over sodium fluoride.

Properties of fluorine

Physical Properties :- Fluorine is a pale greenish yellow gas. Somewhat paler than chlorine. It possesses characteristic strong pungent odour resembling that of a mixture of ozone and chlorine. It can be condensed to a yellow liquid boiling at -188°C and a pale yellow solid melting at -22°C . The relative vapour density indicates a diatomic molecules.

[Rest Part Next Pdf]