High-purity Hydrogen Fluoride

PEP Review 2026-01

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Glossary

$/t	Dollars per metric ton
¢/lb	Cents per pound
AACE	Association for the Advancement of Cost Engineering
AHF	anhydrous hydrogen fluoride
atm	Atmospheres
bara	bar absolute pressure
Bcm	Billion cubic meters
BFD	Block flow diagram
BLI	Battery limits investment
Btu	British thermal units
CAA	Clean Air Act
Capex	capital expenditure
CFC	chlorofluorocarbon
cP	Centipoise
CPCB	Central Pollution Control Board
CS	Carbon steel
cf/ft^3	Cubic feet
DUHF	depleted uranium hexafluoride
ECP	Electrochemical Plant
EPA	Environmental Protection Agency
FOB	freight on board
FSA	fluorosilicic acid
g	Grams
G&A	general and administrative
gpm	Gallons per minute
h	Hours
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
HP-HP	High-purity hydrogen fluoride
HVAC	heating, ventilating, and air conditioning
IED	Industrial Emissions Directive
kg	Kilograms
kJ	Kilojoules
KTA	Kilotons per annum
kPa	Kilopascals
lb/lb	pounds per pound
LP	Low pressure
mgal	Thousand gallons
mlb	Thousand pounds
MMlb/y	Million pounds per year
MMt	Million metric tons
MMt/y	Million metric tons per year
MOC	material of construction
mol%	Molar percent
mPa	Megapascals
NFC	nuclear fuel cycle
OSBL	outside battery limits
OSHA	Occupational Safety and Health Administration
Opex	operating expenses
PEL	permissible exposure limit
PEP	Process Economics Program
PFAS	perfluoroalkyl substances
PFD	Process flow diagram
ppb	Parts per billion
ppm	Parts per million

psi	Pounds per square inch
psia	Pounds per square inch absolute
psig	Pounds per square inch gauge
PTFE	polytetrafluoroethylene
ROI	Return on investment
s	Second(s)
scf	Standard cubic feet
scm	Standard cubic meter
SS	stainless steel
t	Metric ton
t/y	Metric tons per year
TFC	Total fixed capital
TSCA	Toxic Substances Control Act
USGC	US Gulf Coast
V	Volts
vol%	Volume percent
w/w	Weight for weight
wt%	weight percent

Abstract

High-purity hydrogen fluoride (HP-HF) is widely used in the semiconductor industry, particularly for dry etching of silicon-based materials and surface treatment. Due to its high reactivity, it is also used to form various fluorinated compounds for the production of refrigerants, in metal and plastic industries, as catalyst in refinery applications, and in nuclear applications. Diluted hydrogen fluoride (HF), known as hydrofluoric acid, is used for cleaning, etching, and metal surface treatments. However, production and handling of HP-HF require strict safety and quality control measures due to its corrosive nature and potential health hazards.

The demand and supply dynamics of HP-HF are influenced by several factors, particularly the growth of industries that utilize this chemical, such as semiconductor manufacturing, pharmaceuticals, and specialty chemicals. With significant growth in the semiconductor industry, consumer and automobile electronics, smart devices, and increased demand for several high purity fluorinated chemicals, HP-HF demand has increased at an average rate of ~4% annually in the last decade and is further expected to increase at an average annual rate of ~4%-5% until 2028 [CEH-Fluorspar].

In the Process Economics Program (PEP), not much work has been done on HF production technologies in recent years. The last PEP report on hydrofluoric acid (RP-089) was published in November 1973, which covers the HP-HF production from fluorspar and fluorosilicic acid (FSA) from the phosphate industry. Since then, there has been lot of progress in HF production technology. This review presents the production economics for the high-purity (99.8+% purity) HF production for a 30,000 metric tons per year (t/y) capacity plant at a US Gulf Coast (USGC) location. An iPEP Navigator tool is also attached with the electronic version of this review. The interactive iPEP Navigator process optimization module provides an economic snapshot for the process, allowing the user to select and compare the processes, units, and regions of interest.

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