copenhagen atomics

FLiBe Salt

Produced by
Copenhagen Atomics

FLiBe Salt
Highlights

- Purified FLiBe with best in class oxide-, metal- and moisture contaminations
- Purity levels below 100 ppm for oxides
- Ships in ton scale in special made tanks for safe and convenient handling
- The use of our purified salts reduces corrosion with more than 10x

The molten salts
Introduction

Optimized for High-Temperature Applications

Traditionally commercially available FLiBe salt comes in powder form and needs to be mixed to the eutectic composition, while often containing a large and variable amount of moisture, oxide and metal contaminants.

Therefore, Copenhagen Atomics has developed a high purity grade of FLiBe salt commercially available. The control of these impurities and pre-mixed product enable research groups and companies using molten salt to obtain more reliable and consistent data and less corrosion in processes employing molten salts.

Purified salt

FLiBe undergoes a time consuming purification process to drive out moisture and oxygen from the salt. Purified salt is available in large quantities, intended for large testing requirements or molten salt processes in operation.

Reference	Oxides level	Metals level
High purified	< 100 ppm	< 200 ppm

Specifications

FLiBe Salt Specifications

Reference	FLiBe Eutectic mixture of LiF and BeF2
Constituents	7789-24-4 (LiF) 7787-49-7 (BeF2)
Formula	LiF – BeF2 2:1 molar ratio
Appearance	Solid white
Melting/boiling point	459 °C / 1703 °C
Density (melt)	$\rho(T \text{ in K}) = 2413 - 0.488\ T \quad (kg \cdot m^{-3})$ [1]
Viscosity (melt)	$\mu(T \text{ in K}) = 1.16 \times 10^{-4} \cdot \exp(3755/T)\ (Pa \cdot s)$ [1]
Heat Capacity (melt)	$c_p \approx 2350–2420\ J \cdot kg^{-1} \cdot K^{-1}$
Identified use	Lab/industry chemical
Storage	Store in an inert atmosphere or vacuum
H.S. Code	2826.19.00

Corrosion and Impurities

Copenhagen Atomics has significantly increased the accuracy of measuring impurity in FLiBe salt. Metal impurity is measured through ICP OES and oxide impurity through electrochemical techniques.

See the oxide and metal contaminant level in different grade salts in the table on the right.

Increased accuracy of impurity measurement, leads to increased accuracy of measuring corrosion, as corrosion scales with increased moisture, oxide and metal content.

Corrosion rate decreases substantially with FLiBe salt produced by Copenhagen Atomics.

Corrosion rate induced by Copenhagen Atomics' purified salt is less than 0.01 mm/y*.

Corrosion rate induced by commercially available FLiBe powder is more than 1 mm/year*.

Table of typical impurities

Z	Element	Impurities (ppm)
8	Oxygen (O)	25-90
13	Aluminium (Al)	1-10
14	Silicon (Si)	1-5
24	Chrome (Cr)	5-25
25	Manganese (Mn)	1-5
26	Iron (Fe)	5-25
27	Cobalt (Co)	0-1
28	Nickel (Ni)	0-3
29	Copper (Cu)	0-1
30	Zinc (Zn)	0-1
39	Yttrium (Y)	0-1
40	Zirconium (Zr)	4-50
41	Niobium (Nb)	0-1
42	Molybdenum (Mo)	1-4
	others	2-20
=	Total	45-250

*Corrosion rate in stainless steel 316L at 550 °C in static experiments without galvanic effects.

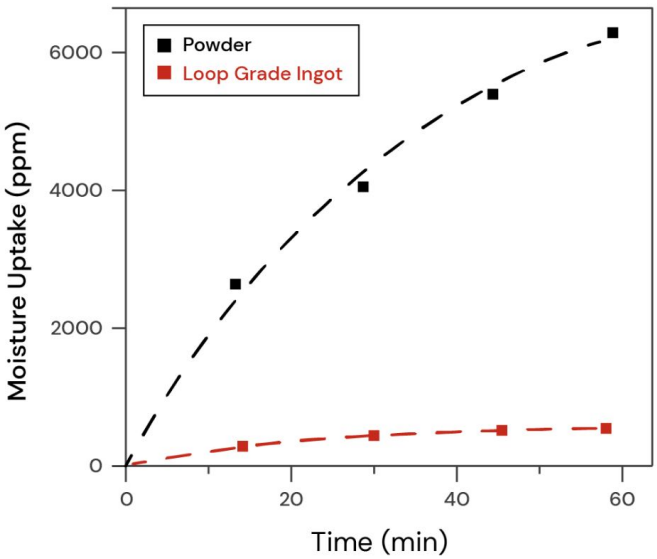
Advantages

Copenhagen Atomics purified salts ships in large tanks.

There is around 10 times the amount of moisture uptake in the powdered salt compared to solid state at each time interval, when exposing the FLiBe salt to air measuring the increase in the mass.

It is challenging to ship and handle salts in powder form without introducing moisture. The handling alone will introduce a large amount of moisture that will potentially result in 5 - 10 times more corrosion of steel.

As the use of Copenhagen Atomics' FLiBe salts will result in significantly less corrosion if handled correctly*, it would be more cost effective to use purified salts from Copenhagen Atomics and stainless steel 316 instead of powder-based salts and more expensive steels, such as Hastelloy N.



Un-refined FLiBe powder	Copenhagen Atomics Salt
Mixing: Time and labour-demanding	Already pre-mixed
Powder form: Dust, loss of material, contamination and electrostatic phenomena	Tanks/ingot/pellet form: Minimum loss of material, minimum dust formation
Hygroscopicity: High specific surface area	Hygroscopicity: Reduced specific surface area
Impurities: Uncontrolled amounts of oxides, moisture and metal traces	Impurities: Minimum moisture, oxides and metal traces

*Copenhagen Atomics will provide guidelines on how to handle the salt in order to minimize the oxygen content in your system during loading and operation.

References

1. Manohar S. Sohal (2013). "Engineering Database of Liquid Salt Thermophysical and Thermochemical Properties," Idaho National Laboratory Report INL/EXT-10-18297.

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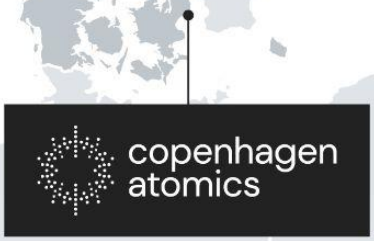

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