Science.
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3M Advanced Materials Division

3M™ 10B Enriched Sodium Pentaborate

Introduction

Ceradyne, Inc., a 3M company, manufactures 3M™ 10B Enriched Sodium Pentaborate to meet the needs of boiling water reactor operators. A ruling from the U.S. Nuclear Regulatory Commission requires these operators to upgrade their standby liquid control systems. Enriched boron offers an easy, cost-effective solution that may not require redesign/retrofit of existing facilities or systems. Ceradyne's ability to produce enriched sodium pentaborate customized for each reactor's conditions eliminates the need for costly and confusing mixing of enriched boric acid and natural borax at the reactor site.

More recently, the use of higher fuel enrichments and the popularity of MOX fuels have placed further demands on reactivity controls at boiling water reactor sites. 3M 10B enriched sodium pentaborate provides an excellent solution for these new requirements. Ceradyne has the ability to tailor and produce the exact enriched boron product for each customer's needs. 3M 10B enriched sodium pentaborate and its related products have found application in various areas of the nuclear power industry. We manufacture a standard grade of highly enriched sodium pentaborate for use in most reactor applications where operators wish to blend on site to achieve final enrichment. For those desiring custom enrichments, non-standard materials are available.

Typical Physical Properties

(Not for specification purposes)

Composition	3M™ 10B Enriched Sodium Pentaborate
Form	White Crystals
Formula	$Na_2O•5B_2O_3•10H_2O$
Specific Gravity	1.71 grams/cc(natural)
Boron Content	17.21% @ 99% ^{10}B
Thermal (n,∝) Cross Section (Barns)	3837

Characteristic	Typical Range
Boron Enrichment	96 wt% ^{10}B min
Equivalent $Na_2O•5B_2O_3•10H_2O$	99.0 wt% min

Impurities	
Calcium (Ca)	30 ppm max
Chlorine (Cl)	2.0 ppm max
Fluorine (F)	5.0 ppm max
Heavy Metals (Pb)	2.0 ppm max
Iron (Fe)	2.0 ppm max
Phosphates (P)	10.0 ppm max
Sulfates (S)	2.0 ppm max
Water Insolubles	10 ppm max

Solubility in Water

(natural isotopic composition)

Temperature (°C)	% Anhydrous Salt by Weight
0	6.28
10	8.10
20	10.55
30	13.75
40	17.40
50	21.80
60	26.90
70	32.25
80	37.84
90	43.80
100	50.30

Boron Enrichment Capabilities

Ceradyne is a leading global commercial processor of enriched boron, and is one of the largest boron isotope enrichment facilities in the world today. We focus on manufacturing optimized materials with an emphasis on stable boron isotopes. Our proprietary manufacturing processes allow ^{10}B and ^{11}B enrichment from natural occurring ratios up to levels exceeding 99% isotopic purity. We offer secure supply, consistent product quality and the ability to custom engineer products for your unique applications. Our specialists are experts at solving materials-related problems in the demanding nuclear and semiconductor industries. For more information, contact us at **boron@mmm.com**.

Analytical Services

As a manufacturer of specialty, high purity chemical and isotopic products, Ceradyne maintains sophisticated analytical and testing capabilities at its manufacturing facility in Quapaw, OK. Our analytical laboratories support on-site production activities and provide our customers with data and evidence that the products they receive meet or exceed their requirements. Our laboratories are fully equipped with current-generation instruments to perform a full range of testing procedures, including: inductively coupled plasma mass spectrometry; atomic absorption spectroscopy; ion and gas chromatography; carbon/sulfur and oxygen/nitrogen analysis; particle size analysis and BET surface area measurement.

Packaging

40 kg per fiber drum, protected by vapor barrier bag. A Certificate of Analysis provided with each shipment. Specific enrichments, purities, and particle sizes are available to meet special requirements.

Product Storage, Handling and Safety

Storage: Keep container tightly closed. See product Safety Data Sheet (SDS) for additional information.

Handling: Do not handle until all safety precautions have been read and understood. Do not breathe dust/fume/gas/mist/vapors/spray. Do not get in eyes, on skin, or on clothing. Do not eat, drink or smoke when using this product. Wash thoroughly after handling. Use personal protective equipment (gloves, respirators, etc.) as required. See product Safety Data Sheet (SDS) for additional information.

Safety: Handling of this material may be hazardous. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. See product Safety Data Sheet (SDS) for additional information.

Regulatory Summary

One or more components in this material are approved for specific commercial use under a U.S. EPA Low Volume Exemption.

Approved commercial use:

1. Emergency shutdown coolant in boiling water reactors.

Refer to SDS for additional information.

3M Technical Ceramics

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The management system has been certified according to DIN EN ISO 9001, DIN EN ISO 50001, DIN EN ISO 14001.