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January 19, 1968

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TITLE

PRODUCT SPECIFICATION FOR LITHIUM-ALUMINATE

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TO G. A. Huff

FROM J. P. Keenan *J. P. Keenan*

SUBJECT <u>PRODUCT SPECIFICATION FOR LITHIUM-ALUMINATE</u>

As agreed upon at the January 9, 1968 meeting concerning the K-Reactor E-N demonstration loading, a guideline for a $LiAlO_2$ Product Specification is outlined for your review and comments. Based on past N-Reactor $LiAlO_2$ data and our experience with vendor and on-plant capabilities we recommend the following limits for chemical impurities, isotope concentration, dimensions and moisture:

1. Chemical Impurities

Element	Max. Wt. (ppm)
Antimony	30
Barium	50
Boron	25
Carbon	500
Cadmium	10
Chromium	200
Cobalt	10
Copper	200
Iron	1500
Manganese	50
Silicon	500
Sulfur	500
Zinc	275
Zirconium	275

Antimony, barium, chromium, cobalt, iron, manganese, zinc, and zirconium limits are specified to hold shielding requirements for irradiated targets within ICC limits for off-site shipments. Past experience has shown these impurity levels have not been exceeded and were no problem during irradiation or extraction.

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Boron and cadmium are limited because of their impact on neutron economy. Although cadmium levels created no problem during our coproduct campaign, we did encounter a period where boron levels reached 200 ppm. However, we believe this is mainly a boron contamination problem at the vendor's plant and through liaison contact this level can be reduced. Also, boron levels should be controlled to reduce extraction problems in that it produces helium during irradiation.

Carbon and sulfur levels are specified because of the undesirable effects they produce during the extraction process. Excessive carbon increases extraction costs as more reducing medium is needed to purify the end product. Sulfur also affects extraction process costs; however, our data indicate sulfur levels have not been a major concern here

Copper and silicon are mainly intended for process control, but are specified for check purposes in the product. Copper has never exceeded the above limit. Excessive amounts of silicon would increase pellet hardness and affect density.

In addition to the above elements we intend to analyze incoming powder for sodium, fluorine, chlorine, and calcium for process control purposes.

2. Li^6 Concentration

For a product specification we believe a meaningful method is to specify the weight of Li^6 per unit volume of sintered $LiAlO_2$. This ratio is determined according to the following equation:

$$\underset{\text{(wt. ratio)}}{\text{Total Li in the } LiAlO_2} \times \underset{\text{(wt. ratio)}}{Li^6/Li \text{ in the } LiAlO_2} \times \underset{\text{(wt. per volume)}}{\text{sintered density}} =$$

$$\text{weight of } Li^6 \text{ per unit volume of sintered } LiAlO_2.$$

Assuming the Li^6/Li ratio is adjusted to 17-19 a/o (14.926 - 16.743 w/o), the stoichiometry to 9.7 - 10.2 w/o Li in $LiAlO_2$ and the sintered density to 78 ± 5% of theoretical (1.91 - 2.17 g/cc) the finished product would contain 32.3654 ± 4.6935 mg Li^6 per cc of $LiAlO_2$. This variation in isotopic content is equivalent to a range of ± 14.5% per element around nominal. The same variation in the earlier N-Fuels campaign was ± 10%.

We believe the above Li^6 concentration per element is a realistic figure for the relatively small $LiAlO_2$ demonstration load planned under this program. If a more stringent control of Li^6 per element is needed it may require more powder processing off-site to meet the tighter limits for stoichiometry and isotope level because blending will be required and an excessive amount of reject and recycle powder may be produced.

3. Pellet Dimensions

We anticipate no problems meeting the target dimensional specifications as shown on Drawing H-3-24303.

[redacted]

4. Moisture

During our coproduct run the moisture was limited to 150 ppm maximum and we recommend the same for K-size targets. Moisture levels are a direct function of time between pellet drying and pellet assembly. There has been some concern from your people to extend cooling time to allow sufficient pellet cool-down prior to assembly so that no annealing of your aluminum components will occur. This may necessitate changes from our assembly procedures, but this is a process problem which can be overcome through experience and tests of pellet cooling rate vs. moisture pickup within our assembly glovebox.

In summary, we have listed product goals that can be met with a minimum amount of cost, time, and effort both here and off-site. We would appreciate any comments you may have on these limits so that a final Product Specification can be drawn up in the near future.

JPK:KRM:mf