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SUBJECT: Study of Dispersant Agents for Thorium Oxide

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Abstract

A preliminary study of dispersing agents for thorium oxide has been completed and several of the dispersants have possible uses. Also many of the industrial dispersing agents tested are not usable with thorium oxide due to induced behavior causing balling and caking. The effects of nitric acid concentration have been observed to also effect each dispersing agent.

DISCLAIMER

The firing of thorium oxide particles in a gas flame presents a problem of moving the dry oxide through a tube into the gas or oxygen stream to be fired. There are several advantages in being able to move the dry oxide instead of using an organic supporting medium to carry the oxide into the flame for calcination. In this study of dispersants, the primary aim was to provide a coating for the thorium oxide particles so that they will flow dispersed at an even flow rate through a small parts feeder to the flame. Under normal conditions, thorium oxide when vibrated cakes on the feeder and only the large undispersed particles will move, leaving the small particles behind in the solid cake.

Under proper conditions, when the thorium oxide is coated, it should flow when shaken without the loss of the small particles due to caking. This study is to evaluate the effects of many of the chemical dispersing agents on thorium oxide in relation to the caking and flowing of the particles.

The desired characteristics of the dispersant is a chemical agent that will coat the particles to keep them from forming aglomerates, also will be burned in calcination or will have no radioactivity during a neutron irradiation. It will also be inexpensive whether low cost or small amount used, or both. The dispersing agents used in this study were products available commercially and have the above characteristics. Most of the dispersing agents were by-products of the pulp industry or sulfonated hydrocarbons which are used as dispersants in other industries.

Experimental

In this study of dispersants, all the samples contained 10 grams of thorium oxide and the amount of dispersant was varied. The dispersants

were dissolved in water and the concentration of dispersing agent range was 1%, 0.1%, and 0.01% with 20 ml being used in each sample.

The 20 ml of the dispersing agent was added to the thorium oxide and the resultant slurry was shaken for 30 minutes to disperse the thorium oxide and to mix the dispersing agent. The slurry was then filtered and allowed to air dry. The dry treated thorium oxide was again shaken on the sieve shaker to evaluate the final dispersed thorium oxide. The treated thorium samples after the final shaking were classified under five headings - balled, caked, powdery, crystaline and/or fluffy. The samples that did not ball or cake were given a final test on the small parts feeder. Some of the dispersants were acidified with nitric acid.

Evaluation of Dispersants

The method of adding the dispersant in a liquid form saves several steps in the production of thorium oxide. The dispersant could be added to the 650°C. find. Thorium oxide during the classification process and also the dispersant may be easier mixed and more even in the liquid form.

The dispersing agents were classified according to the effects produced upon the dry thorium oxide product when they were shaken on the sieve shaker. After shaking, the samples were classified as follows: (1) Balled - the thorium oxide formed spherical balls which were found from the particles and were stable against breaking; (2) Caked - the thorium oxide caked on the bottom and sides of the bottle into a solid mass; (3) Fluffy - the oxide was very light and appeared to have much air space around each particle; (4) Crystalline - upon drying the thorium oxide was a hard mass which required grinding, but does not ball and cake upon shaking. The

fluffy thorium oxide appears to have much better characteristics than the other types of treated thorium oxide.

The following table lists the dispersants and the medium with the final effects of the dispersing. The dispersants were all tested with 1% dispersant, and those that were the most promising dispersing agent were tested under other conditions.

Table I
Effects of Dispersing Agents on Thorium Oxide

Dispersant	1% Solution	0.1% Solution	0.1% + 0.1N HNO_3
TDA-Liquid	B,C	P	--
TDA-Dry	B,C	P,C	--
Vinsol	B,C	P,C	--
Ertrane-C	F	F	F,C,B
Arabiac Gum	B,C	P,C	C,B
Polyfon-O	C	--	F,B
Marsperse-CB	C,B	--	F,B
Polyfon-R	B,C	--	F,B
Marsperse-N	B,C	--	F,B
Gaur Gum	B	P,C	--
Burntonite A78	B	P	C,B
Polyfon-T	B,C	--	F,B
Marsperse-C	B,C	--	F,B
Belliod-TD	B	P	C,B
Maracarb-NC	B,C	--	--
Norlig-A	B,C	--	--
Alrowet-D-65	F,B	--	C,B
Maracarb-C	B,C	--	--
Maracarb-N	B,C	--	--
Polyfon-H	B,C	--	--
Marsperse-CE	B,C	--	--
Polyfon-F	B,C	--	--
Daxad-11	C	P	C,B

B = Balled
C = Caked
F = Fluffy
P = Crystalline and requires grinding.

Discussion

The effects of the dispersing agents on the thorium oxide are dependent on the nitric acid concentration with some effects due to

concentration of dispersant. Upon further experiments with the different normality of nitric acid present, the filter cake was observed to be changed from a fluffy form to a hard crystalline cake which requires grinding. Table I shows some of the effects of the acid when the cake is fluffy and in 0.1N HNO_3. The treated oxide balls (treated with 1N HNO_3). The oxide is hard and required extensive grinding.

The concentration of the dispersant required to coat the particle surfaces of the sample may be observed due to the brown color of the dispersing agents. This is observed when filtering the slurry to see the amount of color on the particle and in the filtered liquid; and when using 0.01% dispersant, there remains some color in the filtrate, indicating an excess of dispersing agent is present.

Additional studies were performed on the better dispersing agents (Table I), and they showed that the effects of dispersant on thorium oxide will change with the acid concentration, but the ideal conditions were not achieved.

The thorium oxide used for the dispersing agent work was 1 micron or less in diameter for the average particles and the dispersing ability may change if the thorium oxide was 2-3 micron average particle size.

The dispersing agents which indicated their usefulness are as follows: Ertrane C, Belliod TD, and Alrowet D-65 and further studies would be required for full evaluation.

Conclusions

There are several dispersing agents which may be usable when the proper acid conditions have been evaluated. Also this study has found a large group of industrial dispersing agents which will not disperse thorium oxide and prevents balling or caking with a vibrating feeder.

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