CY: Austin Astle

NIOSH

Date: January 31, 1994

To: Merril Eisenbud
Paul Kotin
Brian MacMahon
Tom Markham
Marty Powers
Dimitrious Trichopoulos
Jim Stonehouse
Jack Valiquette

From: Hugh D. Hanes

Subject: What Was Unique About the Processing of Beryllium Materials in the Brush-Lorain Plant?

cc: Harnett, Rozek

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Attached is a letter from Jim Stonehouse with a preliminary analysis of this question. For the benefit of those BISAC members who are unacquainted with "Stoney", he joined Brush in 1949 and held various technical positions including Technical Director of the Beryllium Division until his retirement in 1990. He collaborated with Jack Valiquette, who started work at the Luckey Plant at about the same time, holding various Process Engineering positions at Luckey, Elmore, and Delta, and was Plant Manager at the Delta extraction mill when he retired in 1990. Jim is a Metallurgist and Jack a Chemical Engineer. Between them, they have more knowledge of the processing of beryllium than any other living mortals.

What Was Unique about Processing at Lorain?

We are all aware of the abysmal working conditions at this plant as documented by Merril. In fact, the increase in cancer noted in the NIOSH studies was attributed to the very high beryllium air concentrations. Brian in his recent paper attributes this to the smoking history of the workforce as the most plausible confounding factor but leaves the door open to other possibilities. Dimitrious suggested that, based on the findings of IARC, who found that the processing of magenta, rather than magenta, per se, was carcinogenic, we might be able to offer a similar argument for Lorain. Therefore, I posed the hypothetical question to Jim, who consulted with Jack, and reached the conclusions in the attached letter.

In summary, they thought of two possibilities:

1. The reduction of Be_2SO_4 to BeO in an unventilated, gas-fired, rotary kiln, and.

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5100 CFM

2. The use of nickel as a grain-refiner in the unventilated production of CuBe alloys.

How Does This Contrast to Production in the Berylco-Reading Plant?

As noted by Jim, the Berylco process is documented in a publication by the American Society for Metals and he notes two contrasts:

1. The Berylco process for production of BeO was based on direct calcination of the hydroxide, producing mainly water vapor as an effluent, and,

2. Berylco used cobalt as a grain refiner for CuBe alloys.

How Does This Contrast to Production in the Brush-Luckey Plant?

1. The kilns (Jim apparently is uncertain of the type) at Luckey had ventilation and engineering controls in place as a result of the occurrence of CBD at Lorain, and,

2. The Korean War specification for CuBe eliminated the use of nickel as a grain refiner.

As an added note, by the time the Elmore Plant was built and Brush moved operations from Luckey, I believe that we calcined BeO in tunnel kilns, where the sulfate/oxide is in a static bed and the kilns are totally enclosed in ventilation hoods. Jack should be able to provide more specific information on the equipment.

Is the Generation of an Acid Mist as a Result of the Calcination of Beryllium Sulfate a Plausible Explanation for the Increased Occurrence of Cancer in the Lorain Plant?

We think we have the following information:

1. Stoney indicated that he had a conversation with a friend who is a retired engineer with plant experience internationally. This individual expressed the opinion that a gas-fired rotary kiln would be "a perfect acid-mist generator".

2. Merril indicated that there was extensive air sampling of constituents other than beryllium, including H_2SO_4.

3. Merril reminded us of a paper published by Rochester University on the beryllium industry at the time in question.

What Do We Need to Proceed?

1. Before we launch a significant effort, it would be helpful to have a preliminary opinion from Brian and/or Dimitrious as to whether or not this basic premise is reasonable.

2. We should review the IARC monograph on magenta to look for clues as to how the arguments were framed. It would be most helpful if we could identify industry representatives who were involved in those deliberations.

3. We should have a knowledgeable chemical engineer model and analyze the Lorain calcination process, looking for support of the opinion of Stoney's friend and the data taken by Merril.

Although it appears to be less plausible, it would be helpful to have an opinion from Brian and/or Dimitrious as to whether the nickel additions to the CuBe melting could also be a confounder.

I would like to be in a position to present our preliminary thoughts to the NIOSH group during our meeting on March 11. While I don't expect to change their minds on their study results, it will hopefully create some doubt.

I'll contact you all by the end of the week to get your preliminary thoughts.

I was not contacted.

HDH/clh

Attachments

January 19. 1994

Mr. Hugh Hanes
Vice President Governmental Affairs
Brush Wellman Inc.
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Subject: Brief Study of Operations at the Lorain Plant of the Brush Beryllium Co. Relative to Unique Health and Safety Issues.

Dear Hugh:

As per your request. a brief review of the operations at the Lorain Plant of The Brush Beryllium Co. was made relative to factors which were unique to this plant as compared to other beryllium industrial operations. This question is of interest because the data from this plant may indicate that beryllium is a carcinogen.

I have no personal experience on the beryllium operations at Lorain: the fire which terminated beryllium operations occurred in 1948. I joined the company in mid 1949. I did work in the shell of the burned-out plant for about six months on a Zirconium-Hafnium separation contract for the AEC and the Navy. The following suggestions are made on the basis of what I was told by numerous personnel in the early days. the literature and the knowledge of the beryllium industry I gathered over the years. Mr. Jack Valiquette was contacted by phone and several discussions were held on this subject as you requested. Jack also carried out some survey work.

The technical aspects of the processing carried out at Lorain are covered briefly. but well. by the paper authored by C.B. Sawyer and B.R. Kjellgren entitled "Newer Developments in Beryllium" and published in Industrial and Engineering Chemistry, Vol 30. page 501. May. 1938. A copy of this paper is enclosed. The operations of The Beryllium Corporation of America have been described by H. Kawecki in "The Metal Beryllium", Chapter IV B. p.63-70 (White and Burke editors, ASM, 1955).

The factors which appear to be unique in the beryllium operations at Lorain are:

1. Lorain was the only commercial extraction/reduction operation which used the sulfate process to open the ore. beryl. without health and safety precautions. This was due to a lack of knowledge relative to health problems from beryllium during most of its operational period. The Beryllium Corporation used a fluoride process. By the time Luckey operated the sulfate process. ventilation and exposure controls were in use.

See NOTE Sulfate w/ mike was removed

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The conditions in the Lorain plant were described as a continual smoke/fog of chemical fumes by personnel. This can be confirmed by surviving retirees. These fumes were most likely composed of sulfuric acid mists. fluoride vapors and the interaction of these chemicals with ammonia fumes.

2. Beryllium sulfate was fired to beryllium oxide in a ventilated gas-fired rotary kiln. This was possibly the only time that this type of firing was carried. Beryllium Corp. and its successor. KBI. normally fired the hydroxide to produce both alloy feed and ceramic-grade oxide.

The operation of the rotary kiln firing the sulfate. along with the sulfation of beryl in similar equipment. provided a substantial scource of sulfuric acid fumes. The oxide was a major product of the plant supplying the fluorescent light industry. Alloy production increased during the years of World War II to also become a major product.

If the use of the rotary kiln to produce the oxide is deemed significant. the equipment used at Luckey should be researched. I think that the oxide was a very minor product at Luckey, but I may be wrong.

3. The beryllium-copper alloys manufactured at Lorain used nickel as the grain stabilizing agent. The Beryllium Corporation used cobalt for this purpose in the alloys they manufactured. After Lorain burned and the Korean War broke out. military specs were written calling for cobalt. Accordingly, when Brush got back into alloy production. it was neccesary to use cobalt. This was the situation until recently when the price of cobalt forced the re-introduction of nickel.

The lack of protection in the Lorain operation would have provided ample opportunity for nickel and nickel oxide fumes to be air-borne to an extent not present in any other commercial operation. It is of interest to note that the Lorain fire was caused by the failure of an experimental pour of a beryllium-nickel alloy through a small shot tower.

Respectfully submitted.

[signature]

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How much Ni was used at Lorain.

Per NCB Σ ventilation recommended was ~80,000 ft³/min

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