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MONSANTO CHEMICAL COMPANY - UNIT III

PROGRESS REPORT

January 1-15, 1948

SPECIAL REREVIEW
FINAL DETERMINATION

Unclassified
Classification:

Category:

P. B. Dowd
Signature: 5/17/80

1/9/48) Richards

NEUTRON SOURCE GROUP

Bentz, Birden, Hertz (joined group
Schrantz and Watrous

Classification changed to **UNCLASSIFIED**
by authority of Paul B. Dowd, ltr 6/10/70
by Albert J. Weidner, 7/10/70
Reviewed by C.W. Huntington 8/2/79

ABSTRACT

I. Q-Beryllium Neutron Sources

Source JB-13 (PB-103) was prepared and shipped to Chicago 1/6/48. It contained 43.2 cases of postum on 4.11 gram of 230-325 mesh beryllium powder. The neutron count was 1.06×10^8 n./sec., equal to an efficiency of 88 per cent.

II. Q-Fluoborate Neutron Sources

Testing was completed on a method of following by remote control the progress of evaporation during preparation of sources. The acidic vapors are collected in distilled water and the change in resistance followed with an ohmmeter.

III. Two postum-lithium neutron sources were prepared by volatilizing postum into a nickel cylinder, adding lithium, and heating above the melting point of lithium. Source LB-27, containing 0.337 case, reached an efficiency of 60.1 per cent. Source LB-28, containing 0.297 case, was only 31.9 per cent. It is believed that some lithium nitride was present in the latter, thereby lowering its efficiency.

DETAILED REPORT

I. Q-Beryllium Neutron Sources

Source number JB-13 (project no. PB-103) was made by scrubbing 157 ml. of 3 N. nitric acid containing 49.33 C. (1/2/48) with 4.11 g. of -230 + 325 mesh beryllium powder. This is the largest source that has been made in a single scrub.

At the end of 25 minutes of scrubbing, the neutron flux reached a maximum equal to 92 per cent of the final value reached at the end of

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the 9 hour scrub.

After final canning the source contained 43.2 C. (1/5/48) with a neutron emission of 1.06×10^8 n./sec. 1/5/48. The neutron efficiency was 88 per cent.

The sealing and decontamination was accomplished by placing in a thin walled can with pretinned inner lip and soldering a pretinned circular disk in the top by remote control.

The source was shipped to Chicago on 1/6/48.

II. Q-Fluorborate Neutron Sources

Work was completed on an apparatus to determine the dryness of the powder in the evaporation process. The equipment (Figure 1) was designed to absorb the acid fumes in approximately 2 ml. of water and read the resistance on an ohmmeter. Distilled water has a resistance of about 25 megohms and decreases to 7 or 8 megohms when 0.2 to 0.3 ml. of 6 N hydrochloric acid is evaporated and collected in the water.

The apparatus was made of Polystyrene to make it resistant to hydrofluoric, as well as other acids.

III. Q-Lithium Metal Neutron Sources

Two Q-lithium metal neutron sources have been prepared by plating the postum on a platinum spiral coil and then volatilizing the postum onto the inside surface of a cold nickel cylinder. The postum-coated nickel cylinders were then transferred to a carbon dioxide atmosphere in a dry box where the lithium metal was added. Neutron source LB-27, 0.337 C. 1/5/48, had a low efficiency of 25.6 per cent 1/2/48 and gradually reached, with heating and mixing, a peak efficiency of 60.1 per cent 1/12/48. Neutron source LB-28, 0.297 C. 1/9/48, had a low efficiency of 11.7 per cent 1/8/48 and with heating and mixing rounded off at a peak of 31.9 per cent.

The platinum spiral coil (Figure 2) consisted of 22 gauge wire approximately 8" long with its lower lead going up through a quartz tube on the inside of the coil, the quartz acting as an insulator. The coil was made just small enough to clear inside of the nickel cylinder. Two small tips of quartz, just longer than the width of the coil, were fastened onto the quartz insulator to prevent the bottom of the coil touching the cylinder. A platinum hemisphere was fitted over the coil to act as a shield and guide. The surface area of the coil (cathode) was approximately 4 cm². An anode of platinum, 1 x 2 cm., was made up to be used with the cathode.

A simple plating control, consisting of a voltmeter, milliammeter, variable resistor and two dry cell batteries, was used for the plating of postum from 8 ml. of 1.5 N nitric acid.

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—FIGURE 1—
CONDUCTANCE CELL
—SCALE: DOUBLE SIZE—

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— FIGURE 2 —

VOLATILIZATION APPARATUS

— SCALE: ACTUAL SIZE —

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A magnetic stirrer was used to agitate the plating bath. The amperage was under strict control, 8 milliamps, equivalent to a current density of 2 milliamps/sq. cm. The voltage was allowed to vary. Samples of the plating bath were taken during the plating operation and alpha counted in order to determine how the operation was proceeding. When a sufficient amount of postum had been plated out, the coil was removed (current on) from the bath, rinsed in water and acetone. The coil was then placed in the nickel cylinder in the carbon dioxide filled volatilizing chamber and flushed with carbon dioxide. The volatilizing chamber containing the nickel cylinder was immersed in an alcohol-dry ice bath to cool the nickel cylinder prior to volatilizing the postum from the coil. A 5 volt, 60 amp. transformer was used to heat the coil for the volatilization. The coil was heated for 10 seconds to flash the postum. After 10 to 15 minutes the coil was heated again for 10 seconds to flash any postum that might have remained on the coil from the first flashing. The nickel cylinder with postum was calorimetered to determine how much activity was volatilized and condensed.

A gas analyzer was used to determine the carbon dioxide and oxygen in the dry box. A carbon dioxide atmosphere with one-half per cent or less of oxygen was kept in the dry box while the source was being worked on. Small pieces of lithium metal were added to the postum in the nickel cylinder and then heated to just above the melting point of lithium ($186^{\circ}\text{C}.$). The nickel cylinder was tapped vigorously to mix. The source was then neutron counted and treated again by heating above the melting point of postum. After mixing well the source was again neutron counted. The procedure of heating, mixing, and neutron counting was continued until the efficiency reached a maximum. Temperatures of the heater for melting and mixing the sources ranged up to $425^{\circ}\text{C}.$ The nitrogen in the dry box was eliminated by trimming the lithium metal and having the nitrogen react with the lithium to form the black nitride. When the trimmed lithium metal no longer turned black it was believed that the free nitrogen had been removed.

FUTURE PLANS

I. Q-Beryllium Neutron Sources

- (a) Find activity loss in scrubbing apparatus.
- (b) Prepare small experimental sources.

II. Q-Fluoborate Neutron Sources

Prepare 70 unit source.

III. Q-Lithium Neutron Sources

Prepare a source by volatilizing postum onto a lithium coated nickel cylinder in an inert atmosphere.

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Neutron Source Progress Report

John Richmond

JR/rec

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