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DISCUSSION OF RUTHENIUM PROBLEM IN REDOX
PLANT

W. N. Mobley

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HW-30809

CHEMISTRY-SEPARATION PROCESSES
FOR PLUTONIUM AND URANIUM

AEC RESEARCH AND DEVELOPMENT REPORT

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Richland, Washington
February 8, 1954

This document consists of
4 pages.

TO: FILE

DISCUSSION OF RUTHENIUM PROBLEM IN REDOX PLANT

A meeting was held February 5, 1954 in the 2704-Z Building to discuss the ruthenium problem in the Redox Plant and to decide on a course of action to correct the problem. The following persons were in attendance:

Manufacturing

R. S. Bell, Chairman
V. R. Chapman
W. N. Mobley
R. G. Barnes
C. A. Priode
J. R. Cartmell
O. F. Beaulieu
A. R. Keene
C. P. Cabell
T. Prudich
D. R. Koberg

Engineering

C. A. Rohrmann
M. K. Harmon
O. F. Hill
E. M. Johnston
J. O. Ludlow
V. R. Cooper
E. R. Irish

Radiological Sciences

J. W. Healy
R. L. Junkins
M. L. Mickelson
W. A. McAdams
J. M. Smith
D. W. Pearce

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Discussion

Problem

The Redox Plant has been emitting various amounts of ruthenium from the stack

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during recent months. This ruthenium has been determined to be in both the gaseous and solid states. Several weeks ago a major emission of approximately 260 curies of ruthenium occurred following failure of the ruthenium scrubber recirculating pump. This emission caused considerable contamination of the environs of Hanford and as a result caused considerable expense and concern to correct the contamination on roads, equipment, etc., as well as to seriously jeopardize the continuance of various construction work in progress. The scrubber failure was corrected; however, emission rates of ruthenium particles continue to be excessive and have contaminated automotive equipment, railroad locomotives, cask cars, and a construction area immediately adjacent to the Plant. As a result of this contamination, it has been necessary to establish S.W.P. restrictions for the railroad equipment and personnel bringing process materials to the Plant and to remove the construction personnel from the area. Unless the emission can be stopped and the area satisfactorily decontaminated, the construction work will be seriously delayed and could result in a cost increase up to 100% of the labor charges. It could also result in decreased production and, under extreme circumstances, shut down the Plant entirely.

Along with the external contamination problem is the internal problem of ruthenium contamination of the crane and canyon which occurs during cell work.

Action Taken To Date

1. Sampling and analyses of the various emission points have been made in order to determine the source of the problem. This work is continuing due to conflicting results which have been obtained to date.
2. Cold ruthenium studies have been performed in the development laboratories to determine the mechanism by which the ruthenium is being released. This work has been reported in Document HW-29679 and may be summarized as follows:

During the ruthenium volatilization step, RuO_4 is readily volatilized from the liquid state above 25°C . and as long as it remains as RuO_4 is easily removed in the caustic scrubber. It is postulated, however, that due to condensation and thermal decomposition the RuO_4 is reduced to RuO_2 which is not removed by scrubbing but plates out on any metal surface in the equipment and also forms sub-micron size particles which pass through the system and are discharged from the stack. To correct this situation it is then necessary to (1) maintain the ruthenium as RuO_4 where it can be removed in the scrubber system, or (2) design and install equipment to remove both RuO_4 and RuO_2 .

3. Attempts were made to divert the J-1 system (off-gas line from ruthenium oxidizer and scrubber to stack) to discharge into the sand filter for additional particle removal. This work has been unsuccessful to date due to inadequacies in the "as-built" drawings.
4. Design work is progressing on the design of a jumper to divert the J-5 system (plant vessel vent system and fiber glass filter) through the sand filter for additional particle removal.
5. A replacement J-5 filter is being prepared in the shop for installation.

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6. The stack has been flushed with water several times in an attempt to remove any particles which may have been present in the stack.

Steps Which Can Improve Situation

1. Limited data indicate that routing of the vent system through the sand filters will give an additional decontamination factor of 10-15; however, it must be determined what the effect will be on the stack fans from the standpoint of activity build-up which would require remote maintenance of the fans.
2. Sampling of the J-1 system indicates varying efficiencies across the filter which indicates widely fluctuating particle sizes. If particle size can be increased then the present filters would be more efficient.
3. Extensively clean the oxidizer, scrubber, J-1 filter system to remove any particles which may have accumulated and are now being released.
4. Install back-up facilities and operational techniques to minimize the emission through application of ideas determined in the development laboratory (see above).

Action To Be Taken

1. An additional caustic scrubber (J-2) will be designed by the Engineering Department and installed as a back-up for the present scrubber for removal of RuO_4 .
2. A new filter (J-3) will be fabricated by Plant forces and installed following J-2 as a back-up for the J-1 filter.
3. The outlet from J-3 will be routed to the sand filter which will serve as a back-up for the two fiber glass filters (J-1 and J-3) in order to ensure additional particle removal.
4. Operational procedures will be revised in H-4 (oxidizer) to eliminate the sparging, increase the temperature to boiling and to reflux the H-4 tower in an attempt to reduce RuO_4 to RuO_2 which will then stay in the process solution and be removed during centrifugation and in the waste streams. Procedures will also be altered in the scrubber (H-5) whereby an attempt will be made to reflux RuO_2 from the H-6 (condenser).
5. During the present down-time of the plant extensive flushes, using caustic-permanganate and nitric acid-hydrogen peroxide, will be made of the oxidizer-scrubber system in an effort to remove RuO_2 deposited on equipment surfaces.
6. Investigation and location of ozone generators will be made in the event that the above approach does not work and it becomes necessary to ensure that the ruthenium remain as RuO_4 so that the scrubber will remove it.
7. Technical, Process, and Radiation Monitoring personnel will continue to sample and analyze the various streams to monitor the efficiency of the proposed approach.
8. Radiological Sciences will continue to monitor the stack emission and will aid in analyzing the samples to determine the ratio of Ru^{103} to Ru^{106} which will

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allow determination of the age of the material and will more firmly establish the source of the problem.

9. The present J-5 filter will be replaced as soon as feasible and its effluent gas will be diverted to the sand filter.

W. N. Mobley

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