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MINUTES OF HRP GROUP LEADERS MEETING,
AUGUST 18, 1955

By
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October 11, 1955

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HRP GROUP LEADERS MEETING

AUGUST 18, 1955

HRT Status - S. E. Beall

Beall showed several photographs picturing the status of various phases of the HRT construction work. The first picture was an assembly of the fuel low-pressure system which Beall reported was complete and being moved to the 7500 area for experimental testing. The testing will include dump tank evaporation rates, studies of entrainment separator efficiency, condensate collection rates, catalytic recombiner performance, and accuracy of weighing devices.

The photograph of the main reactor tank was presented, and it was pointed out that roof girders were in the process of installation and that some top shielding plugs had been fitted into place. The chemical processing cells were shown in another photograph, and Beall stated that the structural steel fabrication was complete except for welding of the stainless steel liner in cell B.

Several views were also presented of work which has been done on the various control room levels. It was pointed out on the photographs that all control panels, instrument air piping and conduit on the first and second floors had been completed. Water and steam piping progress was shown in photographs of the third and fourth floors.

Beall also reported that the core and pressure vessel assembly had been completed at Newport News Shipbuilding and Dry Dock Company, leak tested and radiographed and that the blast shield was presently being installed outside the pressure vessel. Delivery of the main heat exchangers by the Foster Wheeler Corporation has been delayed because of difficulties in sealing the head-to-tube sheet gasketed joint. Various gasket designs are being studied as are bolt stresses during thermal cycling. Delivery of the heat exchangers is not expected before October. Two of the circulating pumps have been completed at Westinghouse and thermal cycle testing begun. These pumps should be delivered by the end of October.

Over-all HRT shop and field work is presently 12 working days behind schedule.

Physical Properties of ThO₂ Slurry - P. R. Crowley

Several of the physical properties of thorium oxide slurry which are of current engineering interest were discussed. These properties include density, heat capacity, thermal conductivity, viscosity, and sedimentation properties. The properties of density, heat capacity, and thermal conductivity have been listed as functions of temperature and concentration in CF-55-5-54.

It was reported that thorium oxide slurries are classified rheologically as Bingham plastics at low temperature and the consequences of this behavior

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discussed. Equipment was described which is currently being assembled for the measurement of rheological properties up to 300°C. This equipment is a batch pipeline type viscometer, using a modified ORNL pump as an agitator.

The sedimentation of thorium oxide slurries was discussed briefly.

Heat Transfer to Slurries Flowing Turbulently Through Tubes - C. G. Lawson

A review of the literature on heat transfer to slurries was presented with a preliminary program for studying heat transfer.

The conclusions drawn from the literature survey are:

1. The studies made on heat transfer to slurries have been limited to suspensions behaving essentially as Newtonian fluids as demonstrated by shear rate versus shear stress diagrams. For these materials the standard heat transfer equations appear to apply for the prediction of heat transfer coefficients.

2. No method exists for predicting heat transfer coefficients for Bingham plastics; i.e., where the yield stress of the material will be of the same order as the shear stress at the tube wall.

Therefore, a low-pressure 30A loop is being set up where simultaneous heat transfer and pressure drop measurements will be made with a slurry having a high yield stress. It will be possible to obtain data at velocities up to about 25 ft/sec and temperatures up to about 150°C. The purpose of the experiment is to determine whether heat transfer data for high yield stress Bingham plastics can be correlated by the standard heat transfer equations and, if not, how well the predicted and experimental data agree.

Radiation Corrosion of Solutions - G. H. Jenks

(A) MTR Experiment

The preliminary information reported last month is in error with respect to the concentration of U-235. The uranium employed was thought to be 10% enriched but actually was only 1.7%. Hence, the power density from fission was not 3 w/ml but more clearly 0.5 w/ml. As a result of this correlation there is no longer any anomaly in the radiolytic gas pressure for the experiment.

The corrosion rate for the Zircaloy-2 at 280°C was 7 to 8 mpy, comparing to 9 to 10 mpy observed in the LITR experiment at the same temperature but employing 93% enriched uranium. The estimated fission power density for the LITR experiment was 3 w/ml, but because of the high intensity γ and fast-neutron radiation in the MTR the total power developed in solution was about the same in both experiments.

	POWER DENSITY (w/ml)			Corrosion Rates at 280°C
	<u>Fission</u>	<u>γ-rays and Fast Neutrons</u>	<u>Total</u>	
MTR	0.5	3 - 5	4	7 - 8
LITR, Z-12	3	100 - 150	100 - 150	9 - 10

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4.

These results suggest that fission fragment irradiation is not unique in effecting an acceleration of corrosion of Zircaloy-2 by uranyl sulfate solutions, and that fast-neutron irradiation, or gamma irradiation, or both, may also be effective.

(B) LITR Experiment Z-13

Other evidence that exposure to γ -radiation and fast neutrons effects an acceleration of corrosion of Zircaloy-2 has been obtained in bomb experiment Z-13 at the LITR. The solution for this experiment was 0.17 molal in UO_2SO_4 and 0.02 molal in CuSO_4 . The uranium employed contained only 0.03% U-235 so that during exposure in HB-5, the fission power density was less than 0.01 w/ml, i.e., a factor of at least 50 smaller than the estimated 0.5 w/g which is developed by the absorption of γ -rays and fast neutrons in HB-5. Three different temperatures were used, 200°, 280°, then 300°C and finally a second exposure at 250°C. The corrosion rate, calculated from the first portion of the data, is about 3 mpy (250°C). However, the rate of attack appears to decrease after prolonged exposure.

To provide an idea of how these rates compare with those obtained in other experiments, we can say that if the fission power density in this system had been about 5 w/ml, a corrosion rate of 8 - 9 mpy at 250°C would have been predicted. If it is then assumed that the corrosion rate in a given system is directly proportional to the power density, the predicted rate at 0.5 w/ml would be about 1 mpy.

Results of two in-pile bomb experiments were then discussed which were to determine the effect of excess sulfuric acid on the radiation induced corrosion of stainless steel by uranyl sulfate solutions.

The solution composition was:

0.17 molal UO_2SO_4 , 93% enriched

0.01 molal CuSO_4

0.015 molal H_2SO_4

Exposure temperature 250°C

Power density during exposure 5 - 6 w/ml

With the exception of the acid, this solution was the same as that employed in a great majority of the steel bomb tests which have been carried out in the past. The temperature and power density during exposure were also close to those used in previous tests. The present bomb was charged with oxygen to a pressure of about 1100 psi measured at the test temperature. This charge was several times greater than that used in previous tests, which with few exceptions, employed an initial pressure of about 250 psi.

An anomalous behavior of the steady-state pressure of the radiolytic gas is being observed. Aside from this the results of these two experiments indicate that the corrosion resistance of stainless steel under irradiation is improved

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by the combination of excess acid and increased oxygen. Further experiments are planned to check these results and to determine whether the improvement is due to the excess acid or the increased oxygen pressure or both.

The next MTR bomb is scheduled for insertion next week. The solution will be at a uranium concentration of 10 g/liter, 93% enriched. Hence, fission power density will be about 40 w/ml.

Slurry Irradiation Studies - J. P. McBride

The report on this subject followed closely the material appearing in the HRP Quarterly Report, ORNL-1943.

H F McDuffie

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