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MONTHLY PROGRESS REPORT

ON

FUEL ELEMENT DISSOLUTION STUDIES

July, 1958

Nuclear Engineering Department
Brookhaven National Laboratory

Upton, New York

AEC Budget No. 4301

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Brookhaven National Laboratory

M E M O R A N D U M

Date: August 21, 1958

TO: C Williams

FROM: L. P. Hatch, J. J. Reilly, W. H. Regan

SUBJECT: Fuel Element Dissolution Studies During July, 1958

A number of runs were made to investigate the control of the highly exothermic reaction between fluorine and uranium metal by means of a fluidized bed of inert solids. The inert solids were 60 - 100 mesh particles of technical grade CaF_2. The dimensions of the bed were 1 1/2" in diameter and 13" in height, and the top of the reactor was fitted with a 3" diameter disengaging section. UF_6 product was condensed in a cold trap. Test samples were of uranium foil 20 mils thick or thinner when a piece was reused. All samples were etched beforehand in HNO_3 unless otherwise noted. Since the objective of these experiments was to examine the possibility of controlling the reaction between uranium metal and fluorine, no effort was made to achieve a uranium material balance. In all runs the remaining sample piece had either a blackish and/or greenish coating which was not strongly adherent to the base metal. These coatings have been tentatively identified by x-ray analysis as UO_2 and a mixture of uranium fluorides respectively. Results of the experiments are tabulated in the attached table. In runs 11 and 13 a small amount ($\sim$ 1 gm in each case) of white residue was recovered from the bed which is as yet unidentified. The increased reaction rate beginning with run 11 is attributed to increasing the gas velocity resulting in higher bed expansion and more turbulence.

There was no temperature control problem in any experiment and the bed was highly responsive to temperature control by cooling coils and electric heaters. In these experiments it was not necessary to use the cooling coil to control the temperature during any run as the total amount of heat liberated was easily absorbed by the bed with only a small temperature increase. It is felt that this series of experiments demonstrates that it is possible to control such highly exothermic reactions through the use of a fluidized bed. Work in the immediate future will be concerned with a more detailed study of the HCl-Zirconium reaction in a fluidized bed system.

Run #	Gas Composition	Sample Weight grms	Surface Area Cm^2	Temp. °C	Time Runs	Wt. Loss Grms	Reaction Rate mg m/cm^2 x hr	% F_2* Utilized	Remarks
1	5% F_2-95% He	5.35	10	70	15	Slight Gain	-	-	Not etched previously
2	"	5.32	10	225	20	"	-	-	
3	"	5.29	10	300-345	30	1.58	310	-	
4	12% F_2-88% He	7.43	15	275-325	15	0.50	130	-	Not etched previously
5	20% F_2-80% He	7.23	14	325-345		0.98			
6	"	6.52	14	350-380	20	2.76	550		
7	"	6.25	14	375-400	11	1.30	505		
8	50% F_2-50% He	5.34	11	300	12	0.15	67		Not etched previously
9	"	8.09	16	375-395	17	2.52	530		
10	"	5.50	16	425-445	13	2.40	690		
11	"	15.54	37	450-475	21	15.0	1150	~ 50	Increased gas velocity
12	"	12.90	30	400-425	10	6.5	1300	~ 21	" " "
13	65% F_2-35% He	14.78	31	450-475	10	14.78	2700	~ 35	" " "

* The % F_2 utilized is calculated as assuming the entire wt. loss is due to the formation of UF_6.

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