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IN-PILE DEFILMING OF PROCESS TUBES

AUTHOR

A. K. Hardin

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IN-PILE DEFILMING OF PROCESS TUBES

Ref: HW-40120, Same Title, A. K. Hardin to Files, November 28, 1955.

INTRODUCTION

To reduce manpower burn-out rates resulting from contamination on tools and equipment which are used to remove process tubes, a method for decontaminating, by defilming, the process tubes prior to removal from the reactor has been evaluated.

The referenced document reported the results of a small scale test designed to remove film from inside the process tube prior to removal of the tube from the reactor. A more conclusive test was also outlined. The purpose of this document is to report the results of the larger scale test.

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SUMMARY AND CONCLUSIONS

Twenty-two tubes were defilmed at D Reactor during the tube removal outage of December 1955. The tubes were defilmed by inserting a stinger in each individual tube and pumping a 20,000 PPM water mixture of diatomaceous earth at 400 psi through the tube for ten minutes. A flow of approximately 40 gpm per tube was obtained.

To determine the effectiveness of the purge, the tubes were split with a splitting tool of known contamination level. The contamination level of the splitter was measured again as it emerged from the tubes. The results of these data indicated an approximate three-fold reduction in contamination level of the splitting tool. The present purge equipment and high pressure piping to the front face was used for the purge. The elevator time required to purge twenty-two tubes was two hours. It is concluded from this test that the front elevator tube splitting radiation exposure may be reduced by one-third by purging all tubes scheduled for removal. Present purge equipment produces good results and up to twelve tubes per hour can be cleaned. Some additional equipment for the purging operation such as quick connect hoses and couplings may result in a small reduction in the time used per tube. The addition of a pre-mix purge tank and a communication system between the front elevator and purge pump controls are required to reduce labor and provide more effective control of the operation.

It is believed that the data justify the continued use of the defilming method using present equipment and that expenditures for equipment additions required to provide a more effective and controlled operation are justified.

DISCUSSION

Analysis of Defilming Data

Twenty-two tubes were chosen as a representative number to determine the value of the defilming method. The procedure by which the tubes were purged is attached in Appendix I and is self-explanatory. The determination of the decontamination value resulting from the defilming attempt was measured by comparing the readings on 18 splitters used in defilmed tubes with 11 splitters used in filmed or unpurged tubes, see Appendix II. The average readings for the splitters used in the 18 defilmed tubes was 194 m-rad. The average readings for the 11 splitters used in the unpurged tubes was 575 m-rad. The contamination of the splitting tool was reduced by a factor of 2.96. There is reason to believe from a consideration of overall reductions in manpower burn-out for the tube removal work at D, that the value of defilming the process tubes prior to removal may be greater than that which was indicated by means of measuring and comparing splitter contamination readings. For example the air tugger operator normally works in a radiation field of 25 mr. At the D shutdown the radiation level in the vicinity of the tugger was about 15 mr.

Equipment Used and General Observations

The equipment used to purge individual tubes consisted of the present purge equipment and the high pressure water supply to the front elevator. All four purge pumps were operated to obtain the highest pressure and flow available.

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Equipment Used and General Observations (Cont'd)

Three high pressure two inch i.d. flexible metal hoses with front nozzle stinger attachments were used to supply the mixture to individual tubes. It was noted at D Reactor that a pressure of 450 psi was maintained in the front elevator manifold with three stingers in operation. The flow at 450 psi was estimated at 120 GPM. With two stingers in operation the pressure increased to 465 psi. It appears from this data that at least four stingers could be used at one time while maintaining tube inlet pressure at about 400 psi. The total quantity of mixture used was 8,500 gallons for 22 tubes. Since the main purge tank holds only 10,000 gallons, the purging of over 25 tubes will require a method for feeding the main purge tank. A plan for using a pre-mix tank and metering feed to the main tank is being considered.

Time Required for Purging

The time required to purge a number of tubes is mainly dependent on the location of the tubes in the reactor. If the tubes to be removed are situated so that three or four may be purged at one time, the overall time per tube is reduced. At D it was possible to purge 22 tubes in eight set-ups, six set-ups of three each and two set-ups of two each. Including the time required to move from one set-up to the next, two hours were used to purge the 22 tubes. There appears little likelihood of reducing the time required to purge tubes by this method to less than five minutes per tube. Even with one-hundred tubes being removed, the random location of the tubes precludes purging more than four at one time and most set-ups will be limited to three tubes at one time.

Justification and Requirements for Routine Purging of Tubes to be Removed

With a reduction in radiation level of tube removal tools and equipment by a factor of three, the time required for tube removal will be decreased and the large number of people required for tube removal work may be reduced. The relatively small cost of defilming the tubes by purging appears easily justified. Exclusive of the reactor downtime required to purge the tubes, the expense of purging is minor. Diatomaceous earth is \$3.46 per hundred pounds; the material required for a one-hundred tube purge would cost \$200.00. However, to improve the purging operation and reduce reactor downtime, the following new equipment is required for each area which is scheduled to remove more than twenty tubes per month.

1. A pre-mix tank, approximately 1000 gallons capacity.
2. A lightning mixer for the above tank.
3. A dry chemical feeder with a capacity of 1000 pounds of diatomaceous earth per hour.
4. A system for supplying a metered flow of water up to 200 gallons per minute to the pre-mix tank.
5. Five high pressure hoses, 1 1/2 inches i.d. with quick connect couplings on both ends.
6. Quick connect couplings on the high pressure vertical and horizontal manifolds.

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Justification and Requirements for Routine Purging of Tubes to be Removed (Cont'd)

7. A one inch auxiliary water supply on front elevator for cooling tubes during the period between the time the stingers are installed and the purge starts.
8. A communications system (teletalk) between the front elevator and the valve pit.
9. Five stingers with quick connect couplings.
10. Ball valves in series with the present gate valves on the vertical high pressure manifold.

The purchase cost and installation of the above listed equipment probably would not exceed \$6,000 per area.

CONCLUSIONS

Because of the observed results of the test at D Reactor, it is concluded that process tubes should be routinely purged prior to removal, and that further refinements to the present system should be made as soon as possible.

The Process Sub-Section will continue with work directed toward refining the purge method and will provide plans for an improved system as outlined.

A. K. Hardin

A. K. Hardin
Reactor Operations Engineering Unit
Process Sub-Section
REACTOR SECTION

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APPENDIX I

PROCEDURE PROCESS TUBE PURGE
20,000 PPM SUPER-CEL

GENERAL

1. Prepare a purge solution in the main purge tank consisting of 10,000 gallons of water and 1,700 pounds of diatomaceous earth. Pre-mix solution at least five hours prior to test.
2. Valve normal purge system off at feed lines to main Process headers. Open line to front face, high pressure water supply.
3. Install special large mesh screen in top housing of purge system Christmas tree.
4. Install three high pressure hoses on elevator manifold at designated locations and attach stingers..
5. Install high pressure transfer hose on elevator manifold.
6. Isolate Panellit Test system from the high pressure purge system.

PURGING TUBES

The purging of twenty-two tubes will be done in eight set-ups. The sequence for purging is shown in the attached list. Purging steps are given below:

1. Station front elevator at first header on which tubes are to be purged.
2. Connect vertical manifold with elevator manifold transfer line.
3. Valve header to drain on rear and to twenty inches on front. Rear drain must be set to 1608!
4. Valve off Panellit Connection!
5. If tubes contain metal, the following steps must be completed rapidly so that the tubes will not be without coolant longer than five minutes.
 - a. Remove tube caps on the first three tubes to be purged and install stingers.
 - b. Open vertical manifold and three horizontal manifold valves connected to the stingers.
 - c. Start all four purge pumps.
6. If the tubes do not contain metal, they must be loaded with a dummy charge consisting of three 8 inch perforated aluminum dummies, 42 tubular aluminum dummies, and two solid aluminum dummies.

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PURGING TUBES (Cont'd)

7. Monitor tube row temperatures in the control room on the header on which the tubes are being purged. No significant temperature rise is expected but at least the first set of tubes to be purged should be monitored.
8. After a ten minute purge, the purge pumps will be shutdown and the vertical manifold valve closed. The stingers will be removed when the elevator manifold pressure gauge shows pressure to be down, and the tubes will be recapped.
9. The procedure will be repeated for the next three tubes.
10. On the last set of three tubes to be purged, a five minute clear water flush will be made.
11. Shutdown purge pumps and valve high pressure water line out of the system.
12. Flush normal purge lines with clear water prior to reactor startup.

TUBE SEQUENCE FOR PURGING

The Process Tubes listed below are on headers 31-1/2, 33-1/2, 35-1/2 and 37-1/2.

<u>SET UP</u> <u>NUMBER</u>	<u>TUBE NUMBER</u> <u>STINGER - 3</u>	<u>TUBE NUMBER</u> <u>STINGER - 4</u>	<u>TUBE NUMBER</u> <u>STINGER - 5</u>
1	3968	3671	3679
2	3670	3473	3482
3	3465	3471	3379
4	3369	3372	3283
5		3373	3280
6		3374	3377
7	2766	2770	2777
8	2669	2677	2682

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APPENDIX II

SPLITTING TOOL CONTAMINATION LEVEL MEASUREMENTS

<u>PURGED TUBES</u>			<u>UNPURGED TUBES</u>		
Tube No.	Tool Contamination Level		Tube No.	Tool Contamination Level	
	Before	After		Before	After
	Splitting M-rads	Splitting M-rads		Splitting M-rads	Splitting M-rads
3968	0	150	1064	20	500
3670	0	600	1074	15	400
3465	10	150	1176	20	1000
2766	50	660	1162	20	300
2669	75	600	1267	20	750
3671	45	380	1276	15	500
3473	10	85	1370	20	500
3471	10	125	1369	20	500
3372	35	125	1365	15	600
3373	35	100	1467	35	500
3374	45	70	0967	20	1000
2770	75	400			
3679	25	90			
3379	30	135			
3283	10	75			
3280	30	80			
3377	45	110			
2777	10	100			
	(a)	(b)		(c)	(d)

The reduction in contamination level of the splitter used in the purged tubes was calculated by obtaining the sum of each column A, B, C, and D. Then, $\frac{d-a}{a}$ divided by $\frac{b-a}{a} = 2.96$, the factor by which contamination was reduced.

END

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