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SUBJECT: Effect of HRT Core Sample Holder Upon
Core Flow Pattern and Pressure Drop

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A core sample holder, fabricated to Dwg. D-25625, was placed in a full-scale mockup of the HRT core vessel. Water was circulated through the core at rates of 300-400 gpm in order to observe the flow pattern and pressure drop with the holder in place.

Figure 1 illustrates the test arrangement. Dye was injected at indicated locations by means of a tube which could be fixed at any point on the core radius.

Time of travel of dye eddies between two reference points on the holder was measured in order to calculate the approximate velocities shown in Figure 2. Downward flow existed out to approximately 4.5 inches from the holder ring at the equator. The region of downward flow and eddies was not clearly apparent, but would be roughly defined by an ellipsoid whose major (vertical) axis is 16 inches, minor axis 9 inches, and center 2 inches below the equator of the core.

In the case of enriched fuel flow, however, it would be expected that this region would become hotter and less dense than surrounding fluid, thereby gaining an upward velocity from buoyant force. In order to determine qualitatively how effective such a force might be in overcoming the down currents, the core was filled with a dyed methanol solution, specific gravity 0.98. Water at 265 gpm was then circulated through the core, where upon the flow in this region changed to an upward rate of approximately 1 fps, both outside the ring and behind it. This flow rate diminished over a period of 10 seconds, then turned downward again. Two duplicate runs confirmed this pattern.

Pressure drop measurements with and without the holder were made across the core and outlet pipe, as plotted in Figure 3. Pressure drop caused by the holder and samples was 17.7 ft. of fluid at 442 gpm in the outlet pipe. This is 6.9 psi, compared with an estimated pressure drop¹ of 2.8 psi. However, from Figure 3, the difference between ΔP_{1-2} with and without the holder in place, is 5 ft. of fluid, or 1.95 psi.

¹Aven, R. E., Estimates of Temperature Rise and Pressure Drop Effects of Sample Holder in the HRT Core," ORNL-CF-56-7-87.

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The holder rings are located in such a way that they would not affect this pressure drop. Therefore, the basic assumption made in estimating the drop of 2.8 psi, namely, that all pressure drop occurs at the ring assembly of the holder, is in error.

The holder displayed no movement or vibration at the highest flows used, 412 gpm.

CONCLUSIONS

The measured pressure drop across the reactor core, with the sample holder in place, is 6.9 psi, more than twice the estimated value. Better estimates, based on more rigorous mathematical analysis, should be possible for future problems of this type.

The 2 per cent density difference which produced the relatively high velocity of approximately 1 fps, in this experiment, will result from a temperature difference of about 8°C. It is concluded that the bulk fluid temperature near the sample holder will be less than 8°C above the average temperature at the same elevation in the core.

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BAH: job

Attachments

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FIGURE NO. 1
Experimental Set-up
for
Sample Holder Test
1-25-57 BAH

NOTE: Northern core hemisphere
is at top.

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FIGURE NO. 2
Velocity
vs.
Distance from Ring
Flow rate = 400 gpm
1-25-57 BAH

N hemisphere, L

VELOCITY, ft/sec.

S hemisphere, L & R

Equator, L

Equator, R

DISTANCE FROM EDGE OF RING, inches

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FIGURE NO. 3
Pressure Drop vs.
Flow Rate
1-3-57
BAH

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