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PANELLIT PRESSURE EFFECTS WITH A LOOSE FRONT NOZZLE INSERT
K REACTOR I & E SLUGS

July 9, 1958

by

E. D. Waters

Data were obtained in the 189-D Hydraulics Laboratory to determine the effect on Panellit pressure of having a front nozzle insert become detached from the nozzle cap and wash downstream against a charge of I & E fuel elements. A prototypical K reactor process tube assembly (venturi zone) was used to test two different shapes of front nozzle inserts. The data, as shown on Figure 1, indicate that a typical loose nozzle insert would cause a Panellit pressure increase of less than 10 psig and a tube flow reduction of about 1 gpm.

The "tapered" insert is used on poison spline tubes and is shaped as follows (the left end attaches to a cap):

Side View

End View

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Details of this insert are shown on H-1-20845 except that it was modified for use with I & E slugs by drilling a 1/2 inch dia. hole for 5 inches along the axis and a 3/8 inch dia. hole out each side. These drilled holes allow water to flow to the hole channel of the I & E charge if the insert lodges against the I & E's.

The "square end" insert is used on non-poison tubes and is shaped as follows (the left end attaches to a cap):

The pieces of metal plate, which are attached on the bottom of either end of the insert, fit into the spline groove of the front nozzle barrel. The pieces of plate do not prevent the insert from washing downstream. Again, one axial 1/2 inch dia. hole and two peripheral 1/2 inch dia. holes were drilled to allow I & E hole channel flow if the insert should lodge against the I & E charge.

The attached Figure 1 shows the data which were obtained. Values of Panellit pressure and flow rate were recorded for three different front header pressures. Data were first obtained with the nozzle inserts fastened securely to the nozzle cap as a "standard assembly". Then, for each different insert, a wire was used to obtain the proper spacing between the cap and the insert so that the large diameter of the inserts was just covering the nozzle inlet hole. Finally, data were obtained after the insert had been allowed to 'wash' down the tube and rest against the I & E slug charge. To determine the increase in Panellit pressure for a particular location of the nozzle insert, one should follow either of the constant front header pressure curves on Figure 1. (The constant header pressure curves slope downward from the left to the right).

For the first test run with the "square end" insert against the I & E slugs, there was an extra large Panellit pressure increase as shown on Figure 1. When the insert was taken out and put back in, a new set of data compared quite closely with those for the "tapered" insert. This procedure was repeated a second time and the data still compared with the "tapered" insert data. It is suspected that the high Panellit pressures obtained for the first run were due to slug or insert misalignment and therefore would not necessarily represent a typical case.

An unthrottled CG-558 type Panellit gauge with a relay circuit and indicating light was used for several special runs to determine if a Panellit high trip would occur at the instant the nozzle insert came loose from the cap and washed downstream. It was thought that the movement of the insert past the nozzle inlet opening might cause a pressure surge sufficient to result in a high trip even though a static positioning of the insert did not result in a very large Panellit pressure increase.

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However, this was found not to be true. The high trip setting of the Panellit gauge was lowered to be about 10 psi above the average normal Panellit reading before a high trip occurred when the insert was released. In fact, the trip was caused on two or three trials by normal Panellit oscillation before the nozzle insert was freed from the cap. It is concluded that it would be very difficult to detect if or when such a drilled insert became detached from the nozzle cap and lodged against an I & E fuel charge.

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Panellit Pressure - Psig

Flow Rate - Gpm

Figure 1

Panellit Pressure Effects with Loose Nozzle Inserts

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