ERCOSION/CORROSION RESEARCH CENTER

E/CRC NOTES

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Erosion-Corrosion Problems - Can an Inhibitor Help?

When CO_2 gas and sand are produced along with other production fluids, erosion-corrosion can occur in the form of pitting, and penetration rates can be extremely high (see *E/CRC NOTES,* Spring 1995).

The threshold velocity defines the flow velocity above which pitting occurs and depends on environmental factors and on how erosive the conditions are (i.e., the "erosivity"). If the flow velocity is above the threshold velocity, then severe pitting is a risk.

What happens when an inhibitor is added? Fig. I shows the results of some erosion-corrosion testing done at The Erosion/Corrosion Research Center in a flow loop.

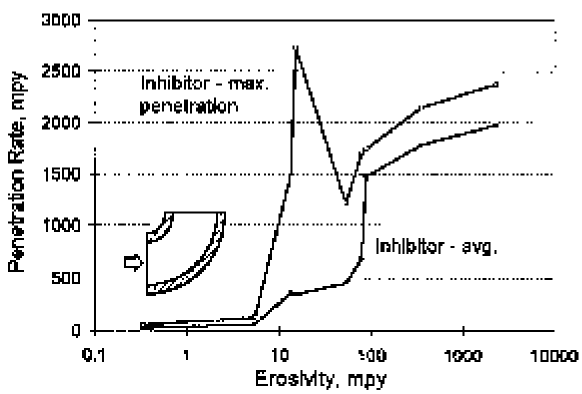

Figure 1. Pitting in Erosion-Corrosion

In these tests, erosion severity (erosivity) was varied for flow through a carbon steel elbow in a CO_2 environment with 100 ppm of a water soluble imidazoline type inhibitor. At the end of each test, wall penetration was measured and the elbow was examined for pitting. The lower curve in Fig. I shows the average penetration rate: the upper curve gives the maximum penetration rate.

Pitting was observed throughout the erosivity range in which the maximum penetration rate was *much* higher than the average penetration rate (between about 5.5 mpy and 90 mpy). Using an inhibitor does not necessarily eliminate pitting.

But, using an inhibitor can have a very important influence on erosion-corrosion - it can shift the pitting threshold upward significantly. The threshold erosivity found in Fig. 1 was 65 times the threshold erosivity found in similar testing without an inhibitor.

If the threshold erosivity is increased by using an inhibitor, then the threshold *velocity* is increased also.

Fig. 2 shows threshold velocity curves for varying pipe size where the fluid is CO_2 saturated water. For a pipe size of 2 inches, for example, using an inhibitor can increase the threshold velocity from about 15 ft/s to 100 fits (well above normal single phase liquid flow rates).

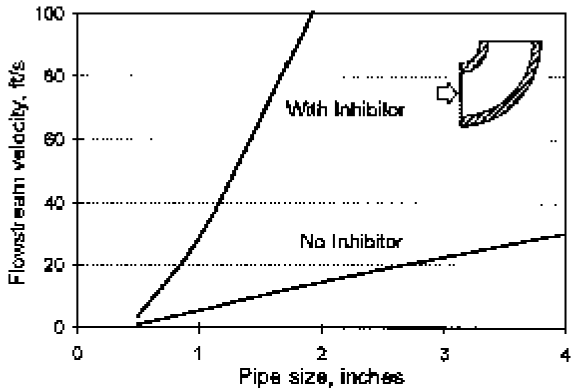

Figure 2. Threshold velocity curves for 10 lb/d, 180 μm sand in CO_2 saturated water at 200 ° F.

Threshold velocity curves for sand entrained in methane are shown in Fig. 3. Enough water and CO_2 gas are assumed in this analysis to enable CO_2 corrosion and iron carbonate *scale* formation cm the elbow wall.

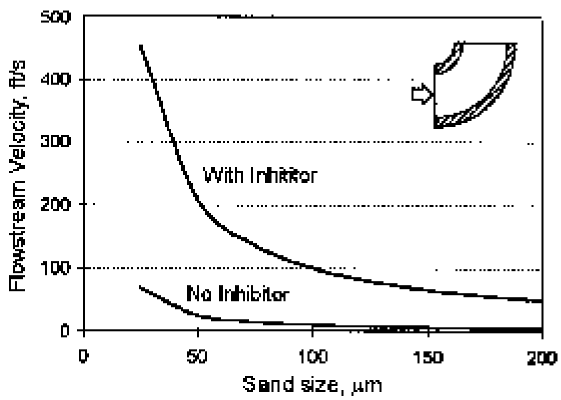

Figure 3. Threshold Velocity Curves for 10 lb/d Sand in Methane at 200° F.

Producing sand in methane usually means very low threshold velocities. But, as Fig. 3 illustrates, using an inhibitor can shift threshold velocities upward to more typical production velocities, at least for small sand sizes.

Erosion/Corrosion Research Center News

A more thorough treatment of the material appearing on the front side of this issue was presented in Paper No. 15 at *Corrosion* 96 in Denver, Colorado. The paper is titled "Velocity Guidelines for Preventing Pitting of Carbon Steel Piping when the Flowing Medium Contains CO_2 and Sand." Authors of the paper were J.R. Shadley, S.A. Shirazi, E. Dayalan, and E.F. Rybicki. Additional threshold velocity examples are provided in this paper, along with the experimental and computational bases for the prediction procedure. Knowing the threshold erosivities provided on the previous page, threshold velocities can be calculated for a range of conditions using the user-friendly program "Sand Production Pipe Saver" (SPPS) available to E/CRC member companies. A demonstration PC version of SPPS is available on a 3-1/2 inch disk from E/CRC secretary Tommie Sue Hampton at (918) 631-2997. Or indicate your interest on the enclosed reply card by checking the box marked "other" and specifying the demo disk.

Recent work at the Erosion/Corrosion Research Center has included addition of long radius elbows in SPPS as a geometry option, and development of a user-friendly version of our CO_2 corrosion prediction program, SPPS: CO_2. Both new versions should be issued at our November 1996 Advisory Board meeting. We hope to see you all there. If you are not a member and would like to come as a guest, see below.

Brief Info on E/CRC

Erosion and corrosion are common problems to oil and gas companies. The Erosion/Corrosion Research Center (E/CRC) at The University of Tulsa was formed to address these problems. The goal of the E/CRC is to help companies identify and evaluate ways of controlling erosion and corrosion through the development of predictive tools and design and operating guidelines. Currently, the E/CRC is supported by thirteen companies from six different countries. Semiannual meetings are held in May and November at The University of Tulsa. Members receive the results of the work in the form of presentations, reports, and user-friendly computer programs. Members provide input to the research through planning meetings and questionnaires. If you would like to receive information on joining The Erosion/Corrosion Research Center, please indicate on the enclosed reply card.

Reply Card

We are in the process of expanding our mailing list for the E/CRC NOTES and encourage you to return the enclosed reply card with the names and addresses of persons who would be interested in receiving the E/CRC NOTES.

If you would like to receive a three-ring binder in which to store your E/CRC NOTES, please so indicate on the enclosed reply card and return to E/CRC.

E/CRC Meetings

The fall E/CRC Advisory Board Meeting is to be held November 13, 1996, at The University of Tulsa. The spring meeting is scheduled for May 22, 1997. If you would like to attend a meeting as a guest, please return the enclosed reply card and indicate that you would like to receive further information on hotel reservations and the specific location of the meeting.