EROSION/CORROSION RESEARCH CENTER

E/CRC NOTES Spring 1995

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Erosion-Corrosion in Oil and Gas Production
How to Avoid Pitting in Sweet Productions When Sand is Present

CO_2 gas, water, and sand make an erosion corrosion environment that can be hazardous to your production tubing, piping, and fittings.

Flow velocity plays an important role in erosion corrosion. At low velocities, protective scale can form everywhere in the piping system and corrosion rates are low. At high velocities, sand particles impinging the surfaces of a fitting such as an elbow prevent protective scales from forming anywhere in the elbow and corrosion rates are high. But at *intermediate* flow velocities, protective scales form everywhere *except at very localized points* where impinging sand particles prevent scale formation. Deep *pits* can form at these points pushing wall penetration rates to extremely high values.

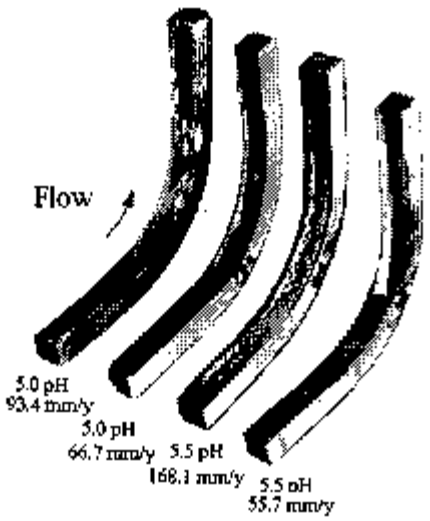

Figure 1. Examples of Pitting in an Elbow

Photographs of some types of pitting found in carbon steel specimens are shown in Figure 1. These specimens were flush-mounted in an elbow and tested in a flow loop circulating sand and CO_2-saturated water.

Factors affecting when pitting will occur include environmental factors such as CO_2 pressure, temperature, and pH, and erosion factors such as flow velocity, pipe size, fluid density and viscosity, and sand size and sand production rate (E/CRC NOTES - Fall 1994).

Threshold velocities mark the boundaries between erosion-corrosion zones. Below the lower threshold, scale forms everywhere and corrosion rates are low. Above the upper threshold, no scale forms anywhere and corrosion rates are high. Between the upper and lower thresholds is pitting. Figure 2

shows how the lower threshold depends on the fluid. For these conditions, if the fluid is water, flow velocities above about 6 or 7 m/s cause pitting.

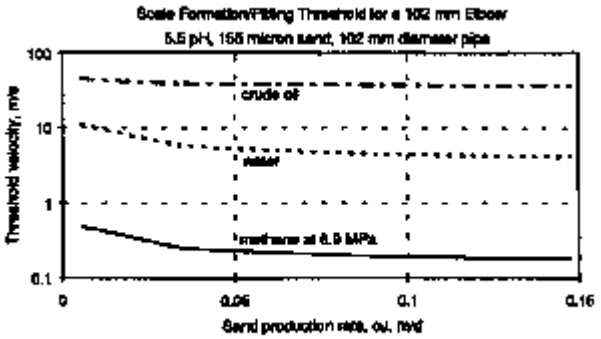

Figure 2. Lower Thresholds

For crude oil under the same conditions, no practical flow velocity would be high enough to cause pitting. For methane, any practical flow velocity is above the lower threshold and pitting would occur unless the velocity were above the upper threshold.

Figure 3 shows the upper and lower thresholds for methane under a different set of conditions as a function of sand particle size.

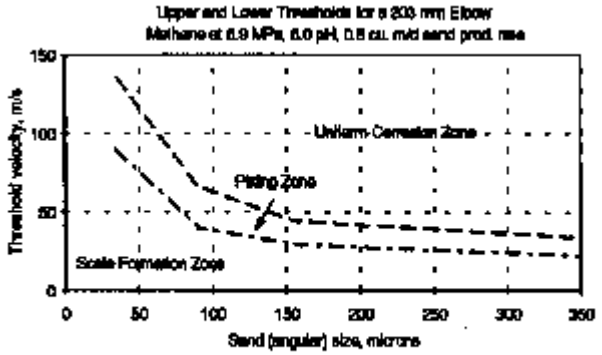

Figure 3. Three Erosion-Corrosion Zones

The objective is to avoid the pitting zone. In this case, whether flow velocities should be high or low depends on the size of the sand particles being produced.

Erosion/Corrosion Research Center News

The photos and graphs on threshold velocities for erosion-corrosion presented on the front side of this issue will appear in Paper No. 95119 to be presented at CORROSION/95 on March 26-31, 1995, in Orlando, Florida. The paper is titled "Erosion-Corrosion of a Carbon Steel Elbow in a CO_2 Environment," and is authored by J. R. Shadley, S. A. Shirazi, E. Dayalan, M. Ismail, and E. F. Rybicki. John Shadley is the Principal Investigator of research at the Erosion/Corrosion Research Center at The University of Tulsa and will be presenting the paper at the conference.

Many other threshold velocity examples are provided in the paper as well as the experimental and theoretical basis for the computational procedure. We hope you will pick up a copy of the paper at the conference for your own corrosion library. The computational procedure for threshold velocities in

erosion-corrosion has been transmitted to our member companies in the form of a user-friendly program that can be run on a PC. We don't have any demonstration copies of this program yet, but we still have some demonstration copies of our erosion prediction program on 3-1/2" disks. This program computes penetration rate and threshold velocities for sand erosion in a number of different piping geometries. If you would like a copy of the erosion demo disk, please so indicate on the enclosed reply card by checking the box marked "other" and by specifying "demo disk "

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 eleven companies from seven 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 Spring Meeting

The next E/CRC Advisory Board Meeting is to be held May 17th, 1995, at The University of Tulsa, Tulsa, Oklahoma. If you would like to attend the 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.