EROSION/CORROSION RESEARCH CENTER

E/CRC NOTES Spring 1998

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The University of Tulsa, KEH L185, 600 S. College Ave., Tulsa, OK 74104-3189
Ph: (918)631-2997, FAX: (918) 631-2397, E-Mail: tommie-hampton@utulsa.edu

Erosion in Long-Radius Elbows and Straight Pipes

Due to limitations of the applicability of API RP 14E in the presence of sand, the Erosion/Corrosion Research Center (E/CRC) has developed models to predict the penetration in fittings resulting from sand erosion. The models are developed from a combination of experimental work and computational modeling. The models are presented to the E/CRC member companies in the form of user-friendly PC based computer programs. The program specific to sand erosion is called SPPS (Sand Production Pipe Saver). Previous versions of SPPS could predict the erosion in standard elbows, tees, and direct impingement. The latest version of SPPS also calculates the erosion in long-radius elbows and straight pipes.

These two extensions to SPPS represent the two primary erosion mechanisms. The most severe erosion occurs in fittings that redirect the flow such as in elbows. The particles can possess enough momentum to traverse the fluid streamlines and impinge the pipe wall. This mechanism is referred to as direct impingement. Erosion can also occur in straight sections of pipe even though there is no mean velocity component directed toward the wall. However, turbulent fluctuations in the flow can provide the particles with momentum in the radial direction forcing them into the pipe wall. Since the turbulent fluctuations are a random process, this erosion mechanism is referred In as random impingement.

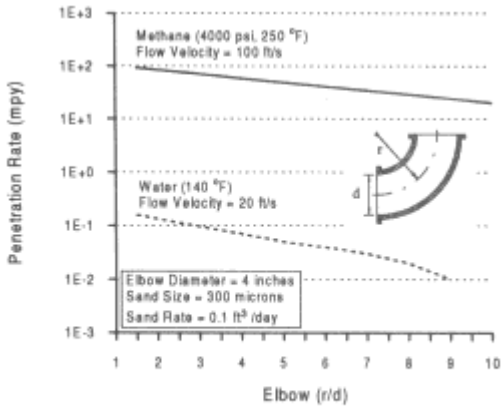

Figure 1. Predicted Penetration Rate versus Elbow Radius of Curvature.

One approach to reduce the erosion in an elbow is to use a long-radius elbow. The effect of elbow radius of curvature on the penetration is shown in Figure 1. This figure provides the predicted penetration rates for a 4 inch elbow exposed to 300 micron sand at a rate of 0.1 ft^3/day (16.5 Ib/day) for both compressed methane at 100 ft/s and water at 20 ft/s. The results demonstrate that as the radius of curvature increases the penetration rate decreases for both gas and liquid. This occurs since the erosion is distributed over a larger area.

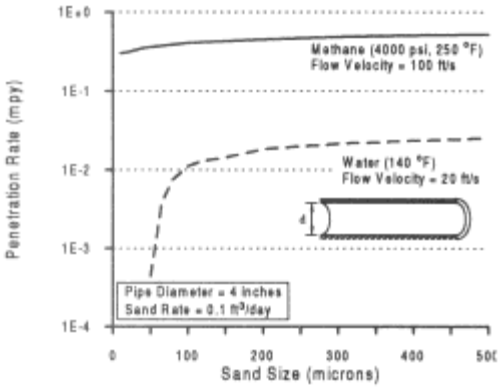

Figure 2. Penetration Rate versus Sand Size.

Erosion in straight pipes is less severe than in an elbow for a comparable set of operating conditions. However, under certain conditions the erosion can be a concern; therefore, a model based on random impingement was developed. This model predicts penetration rate by determining a representative impact velocity in a straight pipe as well as the percentage of particles traveling in the pipe, that impinge the wall.

The straight pipe model can be used to examine the effects of factors such as pipe diameter and flow velocity on the severity of erosion. Figure 2 demonstrates the effect of sand size on the penetration rate for flow in a straight pipe. The flow conditions are the same as in the elbow case. For straight pipes, the sand size does not have a significant effect on the erosion except for the smaller particles in water. The water density is larger than the methane density, so the water can more efficiently reduce the sand velocity as it approaches the wall. This is especially true for the smaller particles. In fact a threshold sand size exists around 100 microns. Below this threshold diameter, the penetration rate decreases rapidly for the given conditions. The effect of sand size in elbows is completely different than straight pipes. For more information on this topic, contact E/CRC.

Erosion/Corrosion Research Center News

Many of you know that Dr. Ethirajulu Dayalan who was a research associate for the Erosion/Corrosion Research Center has left the University, and now works for Eagle-Picher Industries, Inc. in Joplin, MO.. Dr. Dayalan did many good things for the Erosion/Corrosion Research Center and was a good friend to all of us. We wish him well in his new job.

Dr. Jianfeng Chen joined the Erosion/Corrosion Research Center in February 1998 as Research Associate. He has B.S. and M.S. degrees in Chemical Engineering and has a Ph.D. degree in the Department of Metallurgy and Materials from Katholieke University in Leuven, Belgium in 1997. His areas of specialty include corrosion measurements and monitoring, and he has been a key figure in the development of electrochemical emission spectroscopy as a technique for corrosion monitoring. We are very happy to have him join us here at the Erosion/Corrosion Research Center. If you haven't seen the E/CRC web site, you can find it at http://www.ecrc.utulsa.edu. The site tells a little about the Center and the kinds of things that we do here. It also tells you about the Center personnel, when the next E/CRC meeting is, and how to join the Center. You can see past issues of E/CRC Notes or download them in PDF files.

E/CRC personnel are presenting three papers on corrosion and erosion-corrosion at Corrosion/98. All three papers are on Thursday, March 26. See you there?

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 Erosion/ Corrosion Research Center 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 Erosion/Corrosion Research Center is supported by seventeen companies from eight different countries. Semiannual meetings are held in May and November at the University of Tulsa. E/CRC members receive the results of the work in the form of presentations, reports, and user-friendly computer programs. E/CRC 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 spring E/CRC Advisory Board Meeting is to be held May 12, 1998, at The University of Tulsa. The fall meeting is scheduled for November 18, 1998. 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.