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Aging Factor & Hydraulic Calculation

Mojtaba Habibi

Process Engineer at Wood Group

Top Contributor

Dears,

As you know some clients insist to consider aging factor for pipe roughness values to be used for hydraulic calculation.

Based on your real project experiences do you advice such aging factor? If so, which design value to be used as aging factor?

Best,

Mojtaba

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Jeremy

Jeremy Goldbloom

Oil & Energy Professional

My impression has been that the aging factor is already included. The roughness value when the pipe is new will be less than the design value suggested in Crane "Flow of Fluids".

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Wilfredo

Wilfredo Garcia

Process Specialist at Ecopetrol

Mojtaba,

I suggest you to take pressure field data, then make the hydraulics calcs backwards in order to get an estimated roughness. Normally when dealing with existing units hydraulics, we introduce more equivalent length.

Cheers,

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Saeid Rahimi Mofrad

Senior Specialty Process Engineer at Fluor

I assume what is going to affect the frictional pressure drop of pipe during years is the increase in the absolute roughness of the pipe due to corrosion.

I have not seen any green field project which takes this into account while performing hydraulic calculations. But I think if you are working on the revamp of an existing plant after years of being in operation, it makes sense to consider aging factor.

It should be noticed that with this basis no aging factor should be considered for pipes with corrosion resistant alloy (CRA) and non-metallic (GRP or PVC) materials or carbon steel in non-corrosive services.

I could find some figures in different references.

Piping Material ----- Absolute Roughness (mm)

Carbon Steel (CS) non-corroded -----	0.05
Carbon Steel (CS) corroded-----	0.5
Carbon Steel (CS) flare lines-----	0.5
Stainless Steel (SS) -----	0.05
Stainless steel (SS) flare lines-----	0.1
New cast iron-----	0.25
Worn cast iron-----	0.8
Rusty cast iron-----	1.5

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Mojtaba

Mojtaba Habibi

Process Engineer at Wood Group
Top Contributor

Dear Saeid,

Based on your experience could you please shed some light that:

1. If for brown field projects increased absolute roughness can be such that cause major effect on system hydraulic and required pumping power?
2. Why for flare lines the roughness value is higher? Is this because of conservative approach for back pressure calculation or other reason(s)?

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Wilfredo

Wilfredo Garcia

Process Specialist at Ecopetrol

Hi again my friend Mojtaba,

Regarding your question 1, during brown field operations, you find several variables in the hydraulic systems: increased absolute roughness (as you said), "real" equivalent length of pipes and a quite difference in products physical properties; for this reason, it is important that if you're working for a brown field project, get the following information: as built isometrics for the unit; take a field survey including flowrate, pressure, temperature at each section of the products circuit; at the same time, to get laboratory data for feed and products in order to built the "real" plant simulation model.

Regarding your question 2, I would like Saeid reply.

Cheers,

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Saeid Rahimi Mofrad

Senior Specialty Process Engineer at Fluor

1. The effect of roughness increase on the pipe frictional pressure drop is different in liquid and gas services. Read more on <http://www.jmcampbell.com/tip-of-the-month/2009/03/how-sensitive-is-pressure-drop-due-to-friction-with-roughness-factor>

2. I guess using a higher roughness for flare lines (even of SS material) is due to the fact that different types of corrosive gases and liquids are disposed into the flare system, oxygen as a corrosion catalyser can be there (especially during commissioning and maintenance), lower grades of SS is used for flare system (just to satisfy the low temperature requirement - not the likely corrosion issue - check with a metallurgist please), there is no corrosion control and monitoring, and it definitely results in the conservative results for relief valve design.

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Saeid Rahimi Mofrad

Senior Specialty Process Engineer at Fluor

I checked with a material specialist. It is very unlikely to have corrosion in SS lines even with the lowest grade of SS unless there is Chloride (sour water for example) in the system. Presence of oxygen in the flare system (if any) also helps a protective layer to form on the surface of SS.

So most probably, using higher roughness for SS flare lines is a conservative approach for relief

valve backpressure calculation.

Any other idea?

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Jeremy

Jeremy Goldbloom
Oil & Energy Professional

A useful source on piping roughness is Norsok Standard P-001 section 6.1. I would agree that decent quality SS flare lines are unlikely to undergo any corrosion. You should check however, if there could be any deposition of wax or tar.

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Ashraf

Ashraf Abufaris
Process Engineer at Petrofac

Saied,

I am working in a project where they dose corrosion inhibitor in all flare lines through the nitrogen purging line the protect the flare headers . Flare headers are CS for MP flare and LTCS for LTMP flare header. This will reduce the corrosion impact corrosive gases. I always thought that crane roughness factor used are highly conservative and considers the life span for new projects. Please let me know what do u think about my last statement

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Saeid Rahimi Mofrad
Senior Specialty Process Engineer at Fluor

Injection of corrosion inhibitor into the flare (with intermittent flow) is new to me. How the chemical film is maintained over the pipe internal surface when the velocity is highly variable (from zero to very close to Mach)?

Crane states that "Pipe ageing affects both the roughness and inside diameter of the pipe due to corrosion, sedimentation, encrustation with scale , tubercules or other foreign matters." In continuation, it explains the effect of increase in roughness and pipe inside diameter reduction on the head loss and finally concludes that "It is difficult to predict the effect of ageing on head loss due to the number of highly variable factor over the life of the pipeline. Although different studies provide insight into the need to take into account the effect of pipe ageing on head loss calculation, it is not prudent to apply any particular thumb rule to all piping systems. Changes to the pipe properties over time are usually taken into account by adding a design margin to the total head calculation for sizing and selecting a pump."

In appendix section, it specifies the absolute roughness of 0.05mm for a commercial steel pipe which (considering above paragraph) I believe does not take the aging effect into account.

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