Using fuel gas as motive gas for ejector

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

Could you please share your experience on using fuel gas instead of steam for ejector to lower the pressure at top of sour water stripper. Ejector outlet gas is sent to SRU reactor (clause unit). I know how to calculate required steam but I am looking for the method by which fuel gas flow rate can be calculated. Is there any concern using fuel gas instead of steam?

We are decreasing the stripper pressure to reduce the column bottom temperature below 120°C at which $MgCl_2$ hydrolysis to HCl is supposed to start (causing corrosion). Do you have any similar experience? What is the operating pressure and temperature of sour water stripper you have?

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7 comments

Sundeep

Sundeep Gupta
Discipline Manager Process

Saeid,
It seems directionally ok. Some issues which came to my mind:
1) How will you dispose off the fuel gas coming out of the ejectors when SRU is down for some reason. Disposing this stream to acid flare will have concerns due to presence of O_2 in it.
2) As ejector outlet pressure will not be low enough (as in case of steam type), you will need significantly larger amount of fuel gas to provide the vacuum needed.

I have not seen vacuum type sour water strippers, perhaps others can provide input. If, at all required, why not use steam for the purpose?

regards

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Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

Sundeep,
1) We have four trains of SRU downstream so disposal system will be always available. When all SRUs are down whole plant is shutdown. Sour water stripper is going to operate at 1.4 bara (no vacuum) so there is no O_2 ingress.

2) Ejector outlet required pressure is 2.7 bara. Do you have any rule of thumb (the ratio of FG to steam) or method to directly calculate FG (MW=16.0) consumption? Ejector is added to the system when all other equipment and piping have been already ordered. we can not use steam becasue it will condense in downstream system causing sever corrosion (current system MOC is CS + 6 mm CA + heat tracing to prevent condensation).
Using FG is not also perfect because it can adversely impact SRU unit operation.

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Sundeep

Sundeep Gupta
Discipline Manager Process

Saeid,
I was curious to know, if you got any solution to your earlier query. Shall appreciate, if you can share it.

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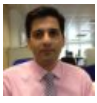

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

There is not much data published about ejector calculations. I searched a lot but I could not find a generally accepted equation or method through which ejector performance can be estimated. But based on correspondence with vendor, I found out that motive fluid flow rate is function of:

• ejector design (throat and nozzle size), ejector suction and discharge pressure
• suction gas flow rate, temperature and molecular weight
• motive fluid pressure, temperature, Cp/Cv and molecular weight

For fixed ejector design, same suction and discharge pressure, if the ejector motive fluid is changed from steam to fuel gas at the same pressure, the difference in motive fluid flow rate is mainly because of Cp/Cv, temperature and molecular weight changes as specified below:

(W steam / W fuel gas) is related to (MW steam / MW fuel gas) ^ 0.5
(W steam / W fuel gas) is related to (T fuel gas / T steam) ^ 0.5

Steam and fuel gas MWs are almost the same but since steam temperature is normally much higher than FG, its consumption will be lower.
The effect of Cp/Cv is extremely non-linear, when Cp/Cv of motive fluid decreases from 1.4 to 1.1, motive fluid consumption can increase up to 6 times depending on ejector design.

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Ali

Ali Abedi Jafari
Project Engineer at Iranian Offshore Oil Company (IOOC)

Dear Mr. Rahimi,
your last post was very helpful. It can not be found in public domains. Do you have access to any catalogs of any vendors to design the gas-gas or liquid-gas ejectors in which formulation or rules are presented. I have some vendors data that can be used for air-water ejectors. but there are no reliable rules to apply in different motive-suction streams.

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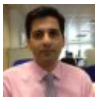

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

Dear Ali,
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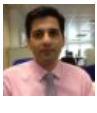

Saeid R. Mofrad
Principal Process Engineer at Petrofac (P.E.)
Top Contributor

'Ejector' unit operation is now a built-in feature in UniSim® Design version R410.

In UniSim® Design R400 and previous versions, the 'Ejector' unit operation was available only as an extension (see Knowledgebase Solution 93). This meant the user needed to manually register the 'Ejector' unit operation with UniSim® Design. This registration process required Administrator rights since a registry change was required and hence may have required IT assistance in a corporate environment.

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