+ Follow Luis 'Li'

Oversizing of separator nozzles - any disadvantages?

Luis 'Li' Heng
Projects Portfolio Manager at Costain Upstream

Hello,

In my experience as an Operations-based Process Engineer, I have faced many instances of production bottlenecks due to nozzle restrictions.

I think it is a shame to restrict production simply because of nozzles, when nozzles could be slightly oversized upon initial design.

Of course, there is always an element of oversizing due to standard piping sizes - ie one calculates the required internal pipe ID for a nozzle and then selects the next standard piping size up.

Properly designed and monitored production capacity tests usually help push the envelope.

However, would there be any major disadvantage in selecting, say, the second next size up?

It is always cheaper to fabricate a vessel with oversized nozzles than modify the vessel or simply add parallel vessels during debottlenecking campaigns. With a larger than required nozzle, one can install an adequately sized piping reduction downstream (or upstream) of the nozzle and, in the future, if production increases, one can easily modify this piece of piping to accommodate larger flowrates.

Personally, I can only see a real problem for inlet nozzles. The size of inlet devices would indeed be proportionate to that of the nozzle, which would affect structural design and cost. However, I still think that it is cheaper to incorporate a larger inlet device upon initial fabrication, rather than retrofit other inlet devices, modify nozzles or install other vessels to adapt to increased production.

Of course, if the initially installed inlet device is, say, a half-open pipe, one can easily retrofit a device which allows higher throughputs. However, if the installed separator is already fitted with the highest-throughput inlet device type, retrofitting becomes tricky.

I have not mentioned any other types of separator bottlenecks herein, as it is an entirely different subject.

Just as for oversized PSVs, which tend to chatter, has anyone - Operations based professional - experienced real-life disadvantages with slightly oversized separator nozzles?

Any views on a theoretical point of view are also welcome.

Thank you in advance.

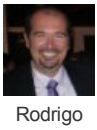
Kind regards,

Luis

Like • Comment (9) • Unfollow • Reply Privately • October 27, 2011

Comments

9 comments



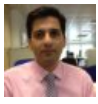
Rodrigo

Rodrigo Lopes de Siqueira
Process Engineer

Dear Luis, I think that the decision depends on point of view of many things, as budget and possibility of the company, marked projection, and many others factors, then it is so difficult to establish some role for that.
In the end, the decision will depend on good sense and knowledge of the engineer to designer the

nozzles of the vessel bigger than it is required, if you know that it will not be there any change foreseen but the coast difference is not so big, probably you will oversize the nozzles, therefore it will be a personal decision.
About PSV, it will depend on what is the worst case, if it was to protect against fire conditions as example, even you change the capacity of the unit, the PSV will be the same, thus you don't need oversize the nozzles and PSV. For other side, if the PSV has to protect some fail in operation condition, you can use the same criterion above to oversize the nozzle to install the PSV, and the PSV you can use one less and adequate for actual condition, thus you have to install an adequately sized piping reduction downstream (or upstream) of the nozzle/PSV. In the future you will can just to change the PSV.
One another possibility is to designer multiples devices to avoid chatter in small emergency or fail operation.
I wait to help you, best regards.

Like • Reply privately • Flag as inappropriate • October 28, 2011



Saeid Rahimi Mofrad
Senior Specialty Process Engineer at Fluor

Luis, I am not sure what limitation you have faced in real plant with vessel nozzles. nozzles are normally sized based on Ro V^2 criteria. There is a range for Ro V^2 for inlet and outlet nozzles not a fixed value. Since it is a range, most probably designer will size the nozzle based on intermediate figure (not higher limit) which may leave some room for future expansion. Furthermore, as you have also mentioned there is always some over-sizing because of selecting the standard pipe size.
1) can you please expalin how you have identified in site that nozzle is limiting.

Apart from this, there are lots of elements (equipment, piping and instrument items) in series with vessel nozzle which have been designed to operate within a specified limit (may be with 10% over-design) and can not be easily retrofitted.
2) can you please explain what is the importance of ease of nozzle retrofit compared to other elements in the system.

Delete • October 29, 2011

david sii likes this

Prasenjit

Prasenjit Ray
Principal Process Engineer at Petrofac International Limited

Luis, I am absolutely of same opinion as Saeid, may be both we are Process designer and we know how we design the vessel or equipment. As a process designer we always keep some margin on and above the specified over design margin (say typically 10%). Its strange that Nozzle is becoming a week link in design. Normally if you follow Shell DEP guide lines, it ensures that the overdesign is sufficient.
However, straight to reply of your question : as such there is no negative impact on oversizing of nozzle. but, any oversize will impact on other downstream engineering. The impact also has to be reviewed and optimized before finalizing the design.

Like • Reply privately • Flag as inappropriate • October 29, 2011

Luis 'Li'

Luis 'Li' Heng
Projects Portfolio Manager at Costain Upstream

Dear Rodrigo,
Thank you for your reply.
However, please note that no part of my question was related to design or sizing of PSVs.
The meaning of my last sentence may me re-phrased as follows:
"Sometimes, oversizing can cause operational problems. For example, Process Engineers know that oversizing PSVs can lead to chattering. Similarly, as far as separator (inlet and outlet) (process) nozzles are concerned, I would like to know, from Operations-based and site-based professionals, whether oversizing of separator (process) nozzles can lead to operational problems."
My question was not at all about PSVs.

Kind regards,
Luis

Like (1) • Reply privately • Flag as inappropriate • October 29, 2011

Rodrigo Lopes de Siqueira likes this

Luis 'Li'

Luis 'Li' Heng
Projects Portfolio Manager at Costain Upstream

Dear Saeid, dear Prasenjit,

Thank you for your replies.

To answer your questions, I am both an Operations support engineer and a design engineer. I was asking about real-life problems on plants, such as excessive corrosion in liquid outlet piping (for liquid nozzles) due to insufficient velocities, formation of unexpected liquid slugs due to too large an inlet nozzle (due to pre-settling in the feed pipe itself) etc. As far as I know, such problems do not occur that noticeably when a nozzle is slightly oversized, but it is better to check with other plant-based professionals.

One of the reasons for my asking is that I specialise in production debottlenecking or constraint identification, that is, I take a design, I turn it around and I explore what operations can do with a given item of equipment. I draw operating envelopes for such equipment items, I identify what needs to be done for the installed equipment capacity to be able to accommodate changing production forecasts. Occasionally, I perform production capacity tests. Working for oil and gas operators, I have faced many instances whereby for example gas break-through occurs and production starts becoming gas-constrained. In such cases, to produce the desired amount of oil, one would have to double gas production, for example. With such orders of magnitude, even the best design margins are sometimes insufficient, especially if watercut has also been on the rise.

In my career, I have seen wiremesh mist extractors ripped apart due to excessive gas velocities (with a fouling fluid), I have seen vane-type inlet devices (Schoepentoetors) knocked off their supports (due to excessive Ro V^2) and lying at the bottom of vessels. In addition to debottlenecking, I advise my clients on how to design equipment not to have to debottleneck unless it is absolutely overwhelmingly necessary. In this perspective, my operations-based experience shows me that it is better to slightly oversize production nozzles on initial design.

Personally, I think nozzle replacement - that is, cutting a vessel up and welding a new nozzle on - is not a good idea, if only on a cost point of view. I also am a support engineer to Cost Estimators and economics show that is is often cheaper to buy a new vessel than to modify one. However, I have seen operating companies modify vessels. What I meant by (production-related) retro-fitting was restricted to vessel internals, such as inlet devices - half-open pipes, vane-type inlet devices etc - or mist extractors. An example of (production-related) retro-fitting would be that, with the same inlet nozzle size, the inlet Ro V^2 can be multiplied by 4 just by replacing a half-open pipe with an vane-type inlet device.

As I previously mentioned, all other types of nozzles (instruments, PSVs etc) and all other types of bottlenecks (area for gas flow, residence time etc) are an entirely different subject all together.

At the end of the day, properly designed production capacity performance tests and proper plant condition monitoring are the best indicators for the real capacity of a plant. However, if it can help on original design, low-cost margins should be applied to make significant cost savings when production profiles deviate from their original forecast.

Thank you for your replies.

Kind regards,

Luis

Like (1) • Reply privately • Flag as inappropriate • October 31, 2011

Rodrigo Lopes de Siqueira likes this

S M

S M Kumar

Process Design Consultant

Luis: I agree with you. It does not cost much to oversize, to go to the next higher inlet size. It will not affect performance by having a higher inlet than required, if that is what you are worried about and seeking inputs.

Cost-wise too having one size bigger inlet nozzle will have negligible impact. As a Cost Estimation support engineer, you would know that material cost is only 30-40% of total installed cost of a vessel; fabrication cost, installation cost and cost of associated piping, instruments PSV/LCV/PI etc are virtually the same. So the cost difference in having a single higher nozzle is nothing.

Then why the process design engineer is not doing it. In real-world engineering, it is difficult to draw the line. If the vessel is designed in-house, a process engineer is likely to spend 1-2 hour on it, without paying attention to this aspect. If it is block-boxed out as a vendor item, each $100 saved goes to vendor's pocket. So he is not going to provide a bigger nozzle. Solution: Asset owners have to think ahead and ask for it.

This large variation in Gas-Oil Ratio or water-cut is an issue particular to upstream operation. And this over-sizing is required only for inlet separators. Other equipment may not require this provision. Downstream operations, such a refinery, ethylene or fertilizer plant do not have similar inflow variation for a given capacity. And upstream engineering practices are derived from downstream practices.

Note: One size more will help only in smaller inlet sizes; that is when you go from 4" to 6". But

not in higher inlet pipe sizes. There are other solutions available, such as pre-flash vessel or inline separator or a piggy-bank vessel to reduce the gas load to an existing separator.

Like (2) • Reply privately • Flag as inappropriate • October 31, 2011

Luis 'Li' Heng, Manikandan Murugaiyan like this

Sampath

Sampath Kumar R

Upstream Process Engineer at Technip

Dear Luis,
Good Day!!!
I do agree with Mr.S M Kumar that having higher inlet / gas outlet nozzles than required will not be a problem in design point.
As you are aware, the nozzles size (ID) is selected based on allowable Rho V^2 of inlet device used in the separators. During the selection stage itself, we will end up choosing standard pipe size for nozzles.Most of the times ID corresponds to the standard pipe size will be higher than the required ID (based on Inlet device allowable Rho V^2).

In my opinion, selecting the nozzle ID higher than the required will not cause operational problem. Could you re-cofirm whether the operational problem you have encountered is due to oversing of Nozzles or any other reasons?

Plz Correct me if I am wrong!!!

Kind Regards

Sampath Kumar R

Like • Reply privately • Flag as inappropriate • November 3, 2011

Navneet

Navneet Suyal

Process Engineer at CB&I Lummus

Dear Luis,
As far as the nozzle size (inlet as well as outlet) of a separator is concerned, the only effect it will have on the performance of the separator, is the pressure drop. As told above, the rho v^2 criteria takes care of the pressure drop thing. But even if you select a slightly oversize nozzle, it will not have any impact on the separator performance. Only that the pressure drop across the separator will come down.
But if you say the wiremesh or other internals being blown apart due to increase in gas flow, then there isn't much a designer can do about it. A designer, while sizing the separator will take an additional margin on the feed flow, but he/she can't do anything if the operations guy let even more flow than that pass through the separator.

For things like unforeseen increase in watercut & gas velocity, even a slightly oversized nozzle will not cater to the production viability, primarily because:
a) Due to increase in gas velocity, the area for gas flow now rendered is much lesser than that required for the desired separation level.
b) The boot (or internal wier) may also become undersized, incase of an unwarranted increase in watercut.

Like • Reply privately • Flag as inappropriate • November 5, 2011

Nilanjan

Nilanjan Bandyopadhyay

Manager - Process Engineering (HOD) at WorleyParsons

Dear Luis,
There is absolutely no technical issue with an oversized nozzle. However, the best way is to address it through an operating scenario (higher throughput) which can be foreseen in the future. The design will automatically take care of the same.
If many years down the line, if we find problem with the nozzle size due to increased throughput beyond the design scenario, retrofitting with specialized internals is the only solution and is very common in industry. The specialized internals allow a much higher velocity at the nozzle (i.e. allows higher rho v2 value).
Procedurally speaking, oversizing the nozzle diameter is not possible by the designer on his own as he follows agreed design criteria/basis. Client/operator needs to issue a formal instruction to the designer/consultant to do so. This is not a great idea as it will have an impact on the CAPEX (note it's not only the nozzle dia, sometimes it may increase the separator dimension as well due to mechanical reason), and it may be significant for a large plant facilities.
Hope it clarifies.
Regards,
Nilanjan

Like • Reply privately • Flag as inappropriate • November 9, 2011