

Centrifugal Compressor – Part 4

Penulis:

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Sometimes, un-comprehensive review of process optimization, fails to recognize the effect of changing set point around compressor. Below are examples how this problem happens.

One of problem in refrigeration system was, how to ensure that there is no liquid carry over to gas phase after condensed liquid is collected and separated at Low Temperature Separator (LTS). The simple solution, is increasing operating pressure in order to reduce actual gas velocity across vessel.

How high is high? Well, this is not a simple question. Because increasing pressure in surface facilities means increasing barrier for gas flowing from subsurface. However, too low in setting pressure at separator has a significant impact in liquid carry over, especially if the system has foaming tendency.

Let we try to increase the suction pressure. How to do it? Please refer to the Process Flow Diagram (PFD) attached.

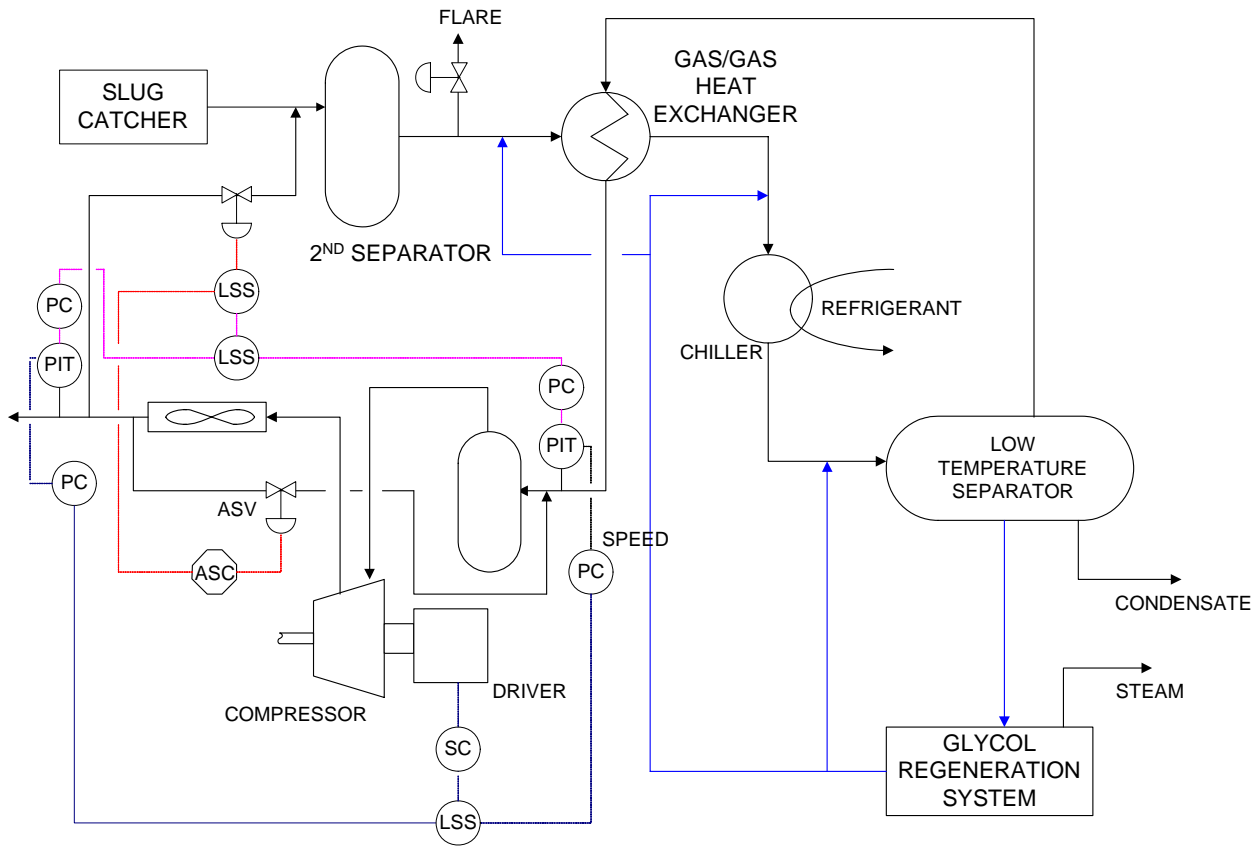
The control of compressor can be simplified below.

The basic control philosophy is "suction pressure control with high discharge pressure override". If the compressor suction pressure goes below the set point, the turbine speed decreases in order to build up the suction pressure. If the suction pressure goes above the set point, the turbine speed increases in order to take in more gas and there by, reduce the suction pressure. However, during this increase in suction pressure, if the discharge pressure goes above its set point, there will not be any further increase in the turbine speed and this would result in the anti-surge or recycle valve opening.

Surge in compressor is caused due to compressor receiving insufficient flow at the operating pressure. The surge in compressor may be avoided by either decreasing the differential pressure across the compressor, or by increasing the flow rate through the compressor. In some case, opening anti-surge valve may cause process not stable, since when this valve opening, usually direct wide open. (In order to bring back compressor operations away from surge).

Recycle system was designed to solve this potential problem. The input from suction and discharge side is compared to get the lowest signal then the output is proceed to the another selector to compare the number with signal from anti-surge controller. So, the system is designed to open the recycle valve first prior anti-surge valve takes action. This hopefully will minimize the plant from transient condition, e.g. to minimize opening anti-surge valve. The recycle system also provides, as total plant outlet controls in case the buyer demand is low below of normal compressor capacity.

Understanding this control principle, then we go to our intention, increase the suction pressure.



The risks that probably come from these actions are:

1. Reducing rate from wells
2. Inadvertent gas to flare due to overlook to raise up setting point of pressure control valve
3. Repetitive compressor's suction scrubber PSV passing to flare line in case compressor shutdown due to increasing in equalize (settle out) pressure of compressor
4. Compressor shutdown caused by hi-hi suction pressure.

Increasing suction pressure is done via increasing pressure setting on speed PC. Then, by automatically, compressor's speed decreases. Let us assume that the wells are still strong enough so it will not make feed to compressor decreases. We also carefully resetting all pressure control valve to flare system as well as verify all pressure switches high-high (PSHHs).

We identified in this case, raising suction pressure did not cause problem on settle out pressure or jeopardize suction scrubber PSV or cause compressor's suction PSHH activated. Everything is OK.

Increasing suction pressure is done. Then suddenly compressor shutdown with notice cool down shutdown alarm.....Anti-surge valve opens and speed of compressor decrease slowly???

Why? Why anti-surge valve open while we are still far from surge region?

Yes, we are still far from surge region, but increasing in suction pressure for given same gas feed means decreasing driver engine speed.

Driver for compressor, usage gas turbine. Gas Turbine operation follows Brayton's cycle. Air is feed to air compressor, that usually have multistage stages and axial type. In combustion chamber, air is mixed with fuel and burn to produce energy heat. This energy is converted to flow energy then create force that able to rotate turbine plus power turbine. Power turbine drives compressor to rotate (work).

Air compressor, also had protection from surge. The normal surge control was bleed off air from its casing via 2 bleed off valves.

As suction pressure increases, the speed of driver decreases. At that time, axial compressor operating region close to its surge region and commands the driver system to allow him opening bleed valves. The further action automatically followed by cool down shutdown.

All above give us a lesson learnt to verify minimum of driver speed (NGP= gas producer speed) as one of parameter that we have to consider during do plant optimization. The simple solution is increasing feed to compressor.

We learnt this today....

Sumber Contekan:

1. The Beauty of Centrifugal Compressor, e-mail pribadi penulis ke milis migas Indonesia.
2. Centrifugal Compressor, Production Manager Standing Order : Increase Gas Rate Immediately to Get More Money!!, e-mail pribadi penulis ke milis migas Indonesia.
3. Centrifugal Compressor, Decreasing Suction Pressure of Compressor, e-mail pribadi penulis ke milis migas Indonesia.