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Compressor Behaviour

Vagif Gafarov
Sr. Process Engineer at KBR

Dear All,

I'd like to discuss and understand the possible behaviour of a compressor connected to a distillation column. Say, there is a two-stage recip compressor (with interim and post water cooling down to ~35 degC) connected to the top of a distillation column at the vapor outlet of a condenser. The vapor coming out of the column is mainly propane-butane @ about 1 barg. The compressor outlet pressure is normally 12 barg. The recycle valve is located at the aftercooler and set out @ 12.1 barg to recycle back extra gas if the outlet pressure exceeds this value. The compressor common motor for two-stages' shaft is 90 kW. What do you expect to happen with the compressor if the column feed is reduced by 50%? at 100% feed the recycle is "just" closed. Can we say that compression ratios at each stage are always equal !?

thanks,
Vagif

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3 comments

Stuart

Stuart Williamson
Dynamic Simulation Consultant at CB&I

Vagif. This is a bit of guesswork, as you haven't fully described the system, for instance it isn't clear how the column pressure is controlled. Assuming the only compressor control is that mentioned above, i.e. at the discharge of the compressor, then possibly the following may occur. Suction pressure would drop to the first stage, resulting in a drop in suction density and also volumetric efficiency for the 1st stage, this would cascade onto the inetrstage section where the pressure and density would also fall, resulting in a similar drop in mass flow and volumetric efficiency for the second stage. This would pass through to the second stage discharge and may result in a fall in pressure at this location. From the sound of it the discharge pressure controller is a limiting control, so it may be that the dsicharge pressure will recover due to some other control mechanism reducing the downstream flow requirement.
The end result may be that no recycle flow occurs and the column pressure falls causing an increase in "heavier" material passing overhead for the column.
Possibly the bit of the picture I am missing is whether there is some form of column overhead pressure control. I would have expected there will be a low pressure controller with an option to open the recycle valve (vai a high selecte relay) but you don't mention this in your description.
All the above makes no consideration of the composition, but if the column pressure falls, and the gas MW increases you may get some lqiuids knocked out interstage or at the discharge.

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Saeid R. Mofrad likes this

Vagif

Vagif Gafarov
Sr. Process Engineer at KB

Hello Stuart,

you are right. This is a pilot plant and its design is yet inclomplete. I'm not involved in this projetc but I have some good connections with process and package engineers there. So far, the column overhead pressure control is not presumed, i.e. it's expected that it will be self-controlled by the compressor.

What would be your guess about consumed power - I suppose that the compressor power usage will also drop !? It's interesting if the column feed is 120% of design can we potentially trip the compressor motor - say it has the protection against too much power consumption, e.g. 105 % of 90 kW.

It's not so straight forward is it))

all the best,
Vagif K

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Stuart

Stuart Williamson
Dynamic Simulation Consultant at CB&I

Hi Vagif
Unless the column pressure control also cascades onto the recycle valve opening, I'm not sure the column will be "self-controlled" by the compressor (if it only has discharge pressure control). Sometimes there can be a separate upstream suction throttle valve for this purpose.
If the throughput and gas density drop, I would expect the power would fall as suggested. For the 120% feed rate case, you are correct in that you could overaload the compressor motor power, but if you had a suction throttle valve then the power could be limited to a maximum limit by suction throttle valve modulation.

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