

Plant Manager+

This is already the eleventh in a series of discussions from a selection of round table topics discussed on the UreaKnowHow.com website. UreaKnowHow.com promotes the exchange of technical information to improve the performance and safety of urea plants. A wide range of round table discussions take place in the field of process design, operations, mechanical issues, maintenance, inspection, safety, environmental concerns, and product quality for urea, ammonia, nitric acid and other fertilizers.

The eleventh subject under discussion is how to run high pressure centrifugal pumps in parallel mode ?

Problem No. 11 How to run high pressure centrifugal pumps in parallel mode ?



What if operators have bad experience with operating critical equipment in certain modes ?

How to convince them that operating in a certain mode should be possible and that it will bring benefits ?

This round table discussion discusses the parallel operation of high pressure centrifugal carbamate pumps. High pressure centrifugal carbamate pumps are critical equipment items and several process requirements needs to be fulfilled to avoid problems and damage. Sharing experiences can help to learn how to operate these critical equipment items and convince operators to overcome their bad experiences.



Mr. João Amilton Raharjo Silva Sampaio of Petrobras in Brasil introduces to the Round Tables a very interesting practical problem:

I have some questions about centrifugal high pressure carbamate pumps. We have two EBARA pumps driven by steam-turbine. The pumps get the carbamate solution from medium pressure recirculation section to the high pressure reactor.

Operating conditions are: Suction pressure: 23 bar, Discharge pressure: 240 bar, Temperature: 100 °C, Flow: 50 m³/h.

About twenty years ago (when I was a child!), an operator tried to put the pumps in parallel arrangement to avoid the shutdown of the CO₂ compressors. When the pumps were put in parallel mode, they suffered serious damage caused by shaft locking. Today operators think the pumps can never operate in parallel mode.

Who knows EBARA high pressure centrifugal pump ?

Is the operator's feeling correct ?

What the reasons can lead shaft locking in a high pressure pump if the equipments are in parallel arrangement ?

Mr. Nawal Gupta of Kribhco in India replies with a possible cause and recommendation:

In parallel operation, flow through each pump might have reduced below the minimum required flow through the pump. This can result in seizure of the pump shaft. If run in parallel, flow should be first increased by recycling.

Mr. Muhammad Farooq of Pak-American Fertilizer Limited in Pakistan confirms the cause and elaborates the previous reply :

Ebara high pressure centrifugal pumps can be operated in parallel provided that you maintain all the requirements like suction flow rate, temperature, pressure and recycle line flow rate. If there is no flow rate through recycle, it will lead to choking and can affect suction flow rate. Operating the pump below the minimum suction flow rate can lead to big damage.

I couldn't understand the relation between shutdown of CO₂ compressor. Would you please elaborate ?

Mr. João Amilton answers:

About the relation between Ebara and CO₂ compressor shutdown.

That is a logic of the DCS to protect the medium pressure recirculation section, especially high level in the absorber and ammonia recovery tower. In a steady-state, if the carbamate recycle pump stops, the system stops the CO₂ compressors. After the CO₂ compressors, the system stops the ammonia pumps. So, the load from reactor doesn't go to medium decomposer tower and the level of medium absorber doesn't increase very fast. During start-up, the logic is by-passed during a certain time to put in operation the pumps and compressors.

Such logic was implemented by operators recommendation.

Mr. Krisnan Hanit of Qafco in Qatar shares his experiences and provides a procedure to switch over from one to the other pump:

Running Ebara or any other pump in parallel mode is difficult or dangerous but you can change over pump in the way described below to avoid a CO₂ compressor trip.

Both pumps discharge pressures will be different and any high pressure carbamate pumps to run in parallel require that the discharge pressure of both lines is almost similar. To avoid a CO₂ compressor trip, you can start one pump on recycle and slowly close the discharge valve of the other running pump to less than 50%. Then stop the pump & close the discharge valve fast. Immediately line up the running recycle pump to system by opening the discharge valve & you can save CO₂ trip without MP absorber level trouble (some level rise will be).

Mr. Riyadi Fikri of P.T. Pupuk Scriwidjaja in Indonesia introduces his interesting experiences:

We are still using Ebara High Pressure carbamate pumps since 1977 until now. Ebara centrifugal pumps were unable to operate in parallel mode for a long time, because we would have difficulties in regulating the flow, pressure and temperature, in normal conditions. The operation of the pump outside its specified conditions will cause a fatal damage. We run parallel pumps only for switching with the standby pump for the purpose of maintenance.

Mr. João Amilton asks some more questions:

What kind of power source do you have for the Ebara pump: steam turbine or electric motor ?
Could you describe the procedures to put your pumps in parallel mode to switch the pumps ?

Mr. Riyadi Fikri replies:

Carbamate recycle solution feed pump EBARA pump specification:

Source Power: Steam turbine, Pressure: 42 kg/cm², Temperature: 390 °C, Liquid pumped: Urea carbamate solution, Inlet temperature carbamate max: 110 °C, min : 80 °C, Capacity: 85 m³/h, Discharge pressure max: 260 kg/cm²G, Normal operation: 250 kg/cm²G, Suction pressure: 24 kg/cm²G, Pump Speed: 6500 rpm, Minimum flow: 38 m³/h.

Procedure parallel pump: Switch A -> B

Pump A : normal operating conditions

Pump B : Vacuum up, Heating up, start with curve performance from vendor until Pressure, Flow, and Temperature are in the same condition with the other pump (Pressure: 250 Kg/cm², Flow: 85 m³/h, Temperature: 100 °C) -> (operation Rate 100%).

Condition Pump B: Discharge fully closed, bypass throttle and then...Pump B -> fully open discharge. Crack open bypass Pump A, close bypass Pump B, close discharge Pump A.

If Pump B in good condition, than stop Pump A with procedures of the vendor. (warning: if below the minimum flow (<38 m³ / h) pump can be damaged).

Mr. Rajkumar Kulkarni of RCF LTD in India shares his valuable experiences:

We can indeed operate EBARA centrifugal pumps in parallel.

As some of us has already mentioned, the parameter to be taken care of is the proper / sufficient suction flow to the pumps. Pump flow is to be controlled by recycle control valve. In no case pump

should be allowed to operate below the minimum flow. The flow meter is in the common suction line of the pumps.



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