Parallel Compressor Load-sharing

Centrifugal compressors don’t always play well together. If two centrifugal compressors are piped in parallel (common suction and discharge piping), the stronger compressor (or the one with slightly less piping friction) will tend to take more of the flow. If the compressors have a common suction drum and the process demand is low enough to require recycle operation, the compressor with the higher piping losses will always do all the recycling. Therefore, when compressors are operated in parallel, the compressor operation will benefit from the inclusion of a load sharing scheme in the compressor control system.

The common technique used by most compressor control vendors is to either balance the compressors' flows or the compressors' surge margins. Both of these techniques have a similar shortcoming: when the operating point of a particular compressor in the network reaches its surge controller setpoint (recycle line), it is taken out of the load sharing scheme. If all the compressors in these schemes reach their recycle line, all the compressors are taken out of the load sharing scheme. At this point, the process controller is no longer able to manage the throughput of the compressors. If the compressor load sharing scheme is completely disabled due to a drop in process demand, the operator must make some decisions about how to deal with the lack of process control. The fact the load has diminished is likely due to some kind of a process upset, so the last thing the operator needs to be dealing with at this point is manual operation of the compressors.

The Tri-Sen Parallel Load Sharing technique keeps all the compressors in the load sharing mode throughout the entire process flow range, without sacrificing the primary control objective. The secret to making all this work is the use of the Tri-Sen Process Demand Scheduler. By using the Process Demand Scheduler to manage the throughput of each compressor, the operating point of each machine is constrained and predictable.

By using the Process Demand Scheduler to manage each compressor, the load sharing function can treat each compressor like a valve. The process controller output is divided between the number of compressors that are online and load sharing. It doesn’t even matter where the process controller is located. If the controller is in the DCS, the individual TSx controllers use their high speed peer-to-peer network to communicate how many compressors are in load sharing mode. The load sharing function is configured in all the TSx systems. All the TSx controllers receive the process controller demand and decide how much of the demand should be sent to its own compressor based on the number of compressors that are load sharing. Each controller on the peer-to-peer network has access to all the data in any controller on the network. If the process controller is in the TSx, all the TSx controllers will have a process controller configured in their control program. Only one controller is active, based on the pre-defined priority. All non-active process controllers are in tracking mode, ready to take control of the process if the lead controller drops off line. No additional hardware is required for process control and load sharing.
Figure 1 – with the Process Demand Schedulers managing the throughput of each compressor, the load sharing function is dramatically simplified. To the load sharing function, each compressor looks like a single valve with a defined capacity range. The output of the process controller is proportionally split to each compressor based on the number of compressors that are online and load sharing.

**Simple yet effective**

By using the Process Demand Schedulers to manage the capacity of each compressor, the load sharing function is dramatically simplified. A simplified control scheme is a lot easier for operators to understand. If the operator understands how the controller works, the operator is more likely to trust the controller and use it.