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Performance Improvement of Multiple Centrifugal Compressors by Interconnection

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Abstract – *In many Industrial Processes where fluids are employed and mainly gases, gases are required to be delivered at specific pressures. Although many times the inlet pressure is different than the desired pressure, and to attain the desired pressure compressors are used. But the usefulness of compressor depends upon the efficiency, the losses and the power consumption. The greater the efficiency, the performance of compressor becomes much better, and along with it reduces power consumption and loss in pressure. But many compressors are not that much efficient or over a period of time due to usage their efficiency becomes low and losses increase. Hence it becomes necessary to analyze the compressor performance and use certain techniques which will improve its efficiency. This report shows the layout of interconnections of compressors in plant during the shutdown of any one compressor. The Failure modes and effects analysis of the centrifugal compressor was done and the required suggestions were given to tackle the problems. This study aims towards interconnection in the centrifugal compressors used in the industry by decreasing the pressure losses through which it led to increase in its urea production whenever there is shutdown or problem in compressor.*

1. INTRODUCTION

In the industry our study was focused around the centrifugal compressors in the Urea plant. In Rashtriya Chemicals and Fertilizers the Urea production plant consists of three separate units of production which require three separate centrifugal compressors. The production of Urea [CO(NH2)2] requires two main constituent which are Ammonia (NH3) and Carbon Dioxide (CO2). During the production of ammonia, one of the main industrials by product is carbon dioxide. If the amount of carbon dioxide produced in the ammonia plant is more than the amount required in the urea plant, then we would have to release the carbon dioxide in the atmosphere. This is both uneconomic and harmful towards the environment. Releasing carbon dioxide in the atmosphere leads to increased temperatures, climate change, acid rain, and harmful effects on human and animal health. In order to avoid this, such excess carbon dioxide should be utilized properly.

2. METHODOLOGY

The simple method is use for interconnection of compressors using valves. There are two types of valves are used isolation valves & interconnection valves between pipelines. Discharge piping should be larger than the compressor connection and should have a smooth run directly from the unit. Refer to the manufacturer for detailed location of check valves, back valves and safety valves. Discharge piping should be larger than the compressor connection and should have a smooth run directly away from the unit. It should not be too large which could possibly create a "stonewall" effect at the discharge. All turns should be "long sweep ells" to allow a minim of backpressure. This is always recommended in any air system but is more critical in a mass flow centrifugal. All piping should slope away from the compressor. All risers should have drain legs. Install a drain leg immediately after the compressor in the discharge line.

Isolation valve: An isolation valve is a valve in a fluid handling system that stops the flow of process media to a given location, usually for maintenance or safety purposes. They can also be used to provide flow logic (selecting one flow path versus another), and to connect external equipment to a system. A valve is classified as an isolation valve because of its intended function in a system, not because of the type of the valve itself. Therefore, many different types of valves can be classified as isolation valves. When a valve has been installed in a series of pipes. When the valve is opened, the fluid starts to flow, and when the valve is closed the fluid stops flowing.

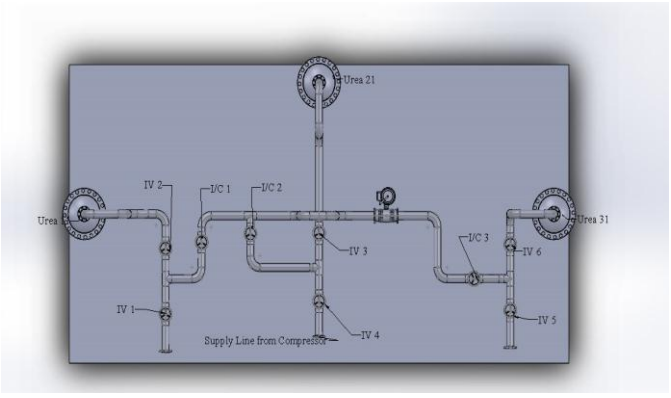

Fig.1

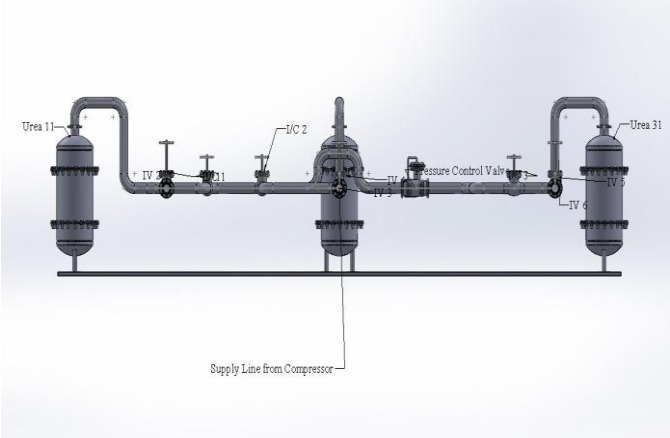

Fig.2

The operation of such interconnection is given below:

1. Case I: Normal working conditions Under normal working conditions each compressor supplies carbon dioxide to its respective reactor. In this condition the interconnection valves are closed.

2. Case II: Compressor 1 is shutdown in this case isolation valve i/v1 is closed and interconnection valve i/c1 only is opened. A pressure valve is provided in common discharge line, so as to equalize the pressure of carbon dioxide from other compressors. Hence carbon dioxide is provided from another compressor to the reactor of compressor 1.

3. Case III: Compressor 2 is shutdown in this case isolation valve i/v4 is closed and interconnection valve i/c2 only is opened. A pressure valve is provided in common discharge line, so as to equalize the pressure of carbon dioxide from other compressors. Hence carbon dioxide is provided from another compressor to the reactor of compressor 2.

4. Case IV: Compressor 3 is shutdown in this case isolation valve i/v5 is closed and interconnection valve i/c3 only is opened. A pressure valve is provided in common discharge line, so as to equalize the pressure of carbon dioxide from other compressors. Hence carbon dioxide is provided from another compressor to the reactor of compressor 3. For these types of interconnection, the proper monitoring system & control unit is needed to avoid any type of risk during operations.

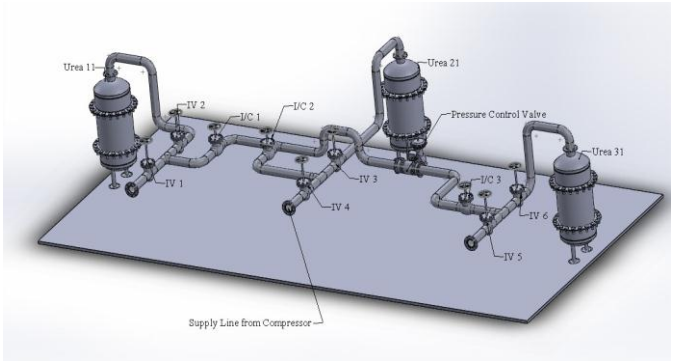

Fig.3

RESULT

As well the procedure of interconnection significantly affects the plant. Interconnecting the three compressor units help in improving performance of the plant. Interconnection allows us to run all three units even if one of the compressors is shutdown or under maintenance. It also helps to save excessive carbon dioxide, as the excessive gas can be conveyed to other plants rather than exhausting it to the atmosphere.

3. CONCLUSION

Through the extensive research and calculations, the problems faced in the company were analyzed and the required suggestion were given to solve the problems. The problems given were regarding the CO_2 compressor used in the Urea Plant. The system designed by us which involves introduction of chiller before the compressor inlet and interconnection of multiple compressor units, increases the efficiency, reduces require power and improves life of the unit.

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