

## Digital positioner TZIDC

Digital valve positioner helps stabilize air separation plant



Boosts argon production up to 10 %

TZIDC

### Introduction

A modern digital positioner from ABB minimizes flowrate swings of rich-liquid vapor at an air separation plant in Louisiana, USA.

The new positioner replaces one installed on the actuator of a 20 inch butterfly valve.

Tighter control of flowrate has helped to stabilize the sensitive cryogenic distillation process, resulting in increased argon production.

### Separation air components

The plant employs cryogenic fractional distillation to separate air into its major components: nitrogen (78 %), oxygen (21 %), argon (0.96 %).

Distillation takes advantage of the different boiling points of the three elements (N 77.36 K, O 90.2 K, and Ar 87.15 K).

According to the plant manager, airflow through the plant is 4.2 million SCFH.

## ... Separation air components Tightening flow control

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01 Digital positioner TZIDC, installed on butterfly valve

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02 Flowrate of rich liquid vapor stays flat and smooth after installation of TZIDC digital electro-pneumatic positioner from ABB (right side of graph)

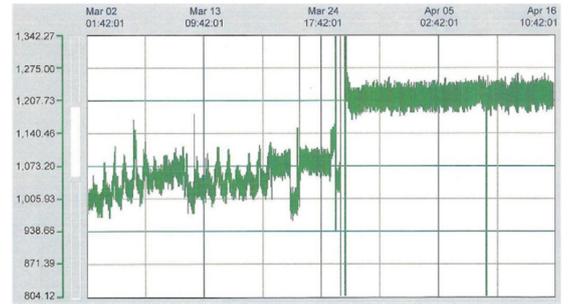
Prior to distillation, the plant first purifies and dries the air to remove contaminants that would become solids at cryogenic temperatures, such as moisture, carbon dioxide, and residual hydrocarbons. A compressor takes the air to about 75 psi, most of which serves as the input to the distillation process. A small sidestream of about 0.5 million SCFH experiences further compression to 110 psi. It subsequently expands to 7 psi to provide cryogenic refrigeration for the distillation columns.

The distillation configuration for this plant has a design that's relatively standard throughout the industry. It consists of three columns as shown in Figure 02. The low-pressure column sits above the high-pressure column. The compressor discharges air directly into the high pressure column. A condenser / reboiler sits between the two. As the incoming air works its way up the column, it loses additional heat. The oxygen continues to liquefy, forming an oxygen-rich liquid at the bottom of the high-pressure column. Nitrogen and argon flow upwards through the low-pressure column. Oxygen is drawn off the bottom and nitrogen comes off the top.



01

The left side of the graph for Figure 3 shows the rich-liquid vapor flowrate swings prior to installation of the digital positioner. The previous positioner wasn't properly controlling the butterfly valve. The plant engineers researched different positioners, concentrating on smart digital units offering tighter control ranges with feedback of the actual valve position. They elected to go with the ABB TZIDC positioner, and created a custom bracket that fit it to the valve.



02

The right half of Figure 03 shows the rich-liquid vapor flowrates following installation of the ABB smart positioner. The plant manager notes that flatter flowrates establish better system equilibrium, maximizing product purity. The plant can now run the columns under tighter control, which results in production of more argon, estimated at about 10 % more.

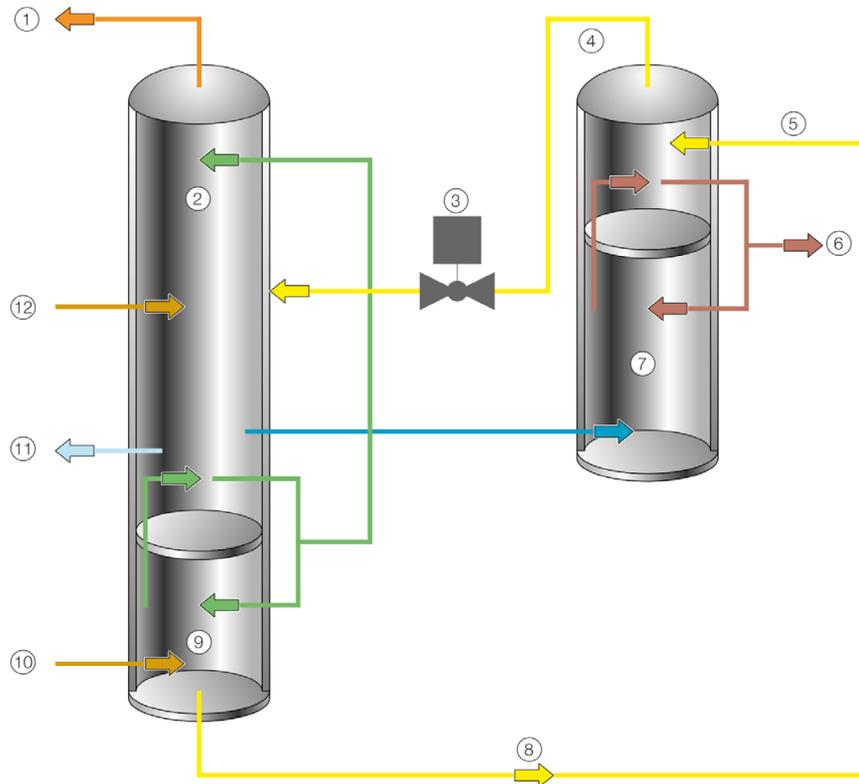
## Drawing-off argon

03 Cryogenic distillation of air produces nitrogen, oxygen, and argon at plant

A middle sidestream from the low-pressure column runs to the bottom of the crude argon column. The sidestream is a saturated gas consisting of roughly 90 % oxygen and 10 % argon. The ultra-cold rich liquid from the bottom of the high-pressure column serves as a condensing fluid at the top of the crude argon column. This liquid is about 40 % oxygen, with the balance being nitrogen.

In the argon column, the condensed argon returns as reflux to the crude argon column, which facilitates the distillation process. Because only 3 degrees K separates the boiling points of oxygen and argon, the operation of the crude argon column is highly sensitive to maintaining its stability.

The condensation of argon vaporizes the rich liquid, which returns as a vapor to the low-pressure column. The amount of rich liquid vaporized has a one-to-one correspondence to the amount of argon condensed. The plant controls the amount of rich-liquid vapor coming off the argon column, which in turn controls the amount of crude argon flow coming in from the low-pressure column. A 20 inch Jamesbury butterfly valve in the rich-liquid vapor line regulates this flowrate.



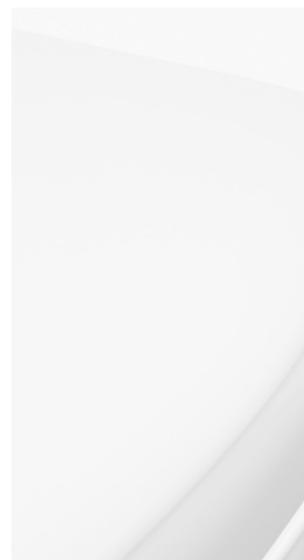
- |                       |   |
|-----------------------|---|
| ① Nitrogen            | ⑦ Argon column                              |
| ② Low pressure column | ⑧ Rich liquid                               |
| ③ Butterfly valve     | ⑨ High pressure column                      |
| ④ Rich liquid vapor   | ⑩ Compressed and purified air               |
| ⑤ Rich liquid         | ⑪ Oxygen                                    |
| ⑥ Argon               | ⑫ Compressed and expanded refrigeration air |

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