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Case study: Designing a natural gas substation to achieve low operational costs

Knovel helps to originate an efficient, small-scale purification system that also ensures safe operation and regulatory compliance

Summary

A large natural gas company needs to build a small-scale processing sub-station to provide gas to a remote community near a large gas field. A lead applications engineer uses answers and insights from Knovel to design a purification system that uses a regenerative adsorbent, resulting in affordable operating costs.

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Relying on the answers and insights available in Knovel, Aldred designed a $4 million gas substation that uses a regenerative adsorbent.

Challenge

A North American multinational corporation—a leading company in the oil and gas industry—undertakes a project that requires the construction of a pipeline in Alaska to transport natural gas from a remote gas field to a distant processing plant. Although this plant will process the vast majority of the gas, the project also requires the company to design and build a small substation close to the gas field. This substation will purify a portion of the field's natural gas for a local community's use.

Levar Aldred*, the lead applications engineer, was tasked with designing the substation. The purification operation at the local substation requires the removal of hydrogen sulfide and carbon dioxide from the gas, as well as a dehydration procedure to eliminate water molecules from it. Removing these impurities is essential to make the gas suitable for consumer fuel use and to prevent pipeline and equipment corrosion. The substation also must purify about 1 metric ton of natural gas per year.

Because this was an unusual project, Aldred could not rely on traditional designs. He needed to find information that would enable him to originate a reliable, efficient process for a small-scale processing plant in a remote, cold-weather location.

*For confidentiality purposes, names have been changed.

[The substation] achieves its target of producing an annual output of 1 metric ton of natural gas for local consumption.

The Minimum Gas Production Rate for Water Removal in Gas Wells

Data presented in this section were generated with Guo's method on the basis of the following parameter values:

Gas-specific gravity:	0.60 to 0.90 air =1
Hole inclination:	0°
Wellhead pressure:	100 to 900 psi
Wellhead temperature:	60 °F
Geothermal gradient:	0.01 °F/ft
Condensate gravity:	70 API
Condensate production rate:	0
Water-specific gravity:	1.08 water = 1
Water production rate:	0 to 50 bbl/day
Solid make:	0
Tubing ID:	1.66 to 3.5 in
Conduit wall roughness:	0.000015 in
Maximum interfacial tension:	60 dyne/cm

Solution

To research his design for the gas-processing substation, Aldred used Knovel to find aggregated and trusted information about a wide range of topics, including how to remove oil and condensate—as well as hydrogen sulfide and carbon dioxide—from natural gas. The standard process for removing hydrogen sulfide and carbon dioxide from natural gas is to use an adsorbent to transform sour gas to sweet gas. Much of his research involved gaining an understanding of the chemical properties of regenerative and nonregenerative adsorbents.

Aldred also needed to design the remote substation to operate reliably and safely. He used Knovel to find materials suitable for cold environments and to research industrial safety, plant design and process refinement topics. He easily discovered critical property data detailing the hazard, toxicity, and carcinogenicity of various potential adsorbents, as well as best practices for handling hydrogen sulfide and carbon dioxide. To ensure compliance with local and national environmental laws, he also consulted Knovel to access regulatory information from the Code of Federal Regulations and other sources.

Table 12-9
Temperature Changes Within an Adiabatic Dehydration Bed

Distance from air inlet, in.	Temperature, °F, for operation times given					
	0 hr	0.5 hr	2.5 hr	4.5 hr	7.0 hr	11 hr
0 (inlet)	75	75	75	75	75	75
3	75	165	105	95	90	85
12	75	95	245	140	115	100
21	75	92	145	235	160	120
30 (outlet)	75	90	93	185	213	170

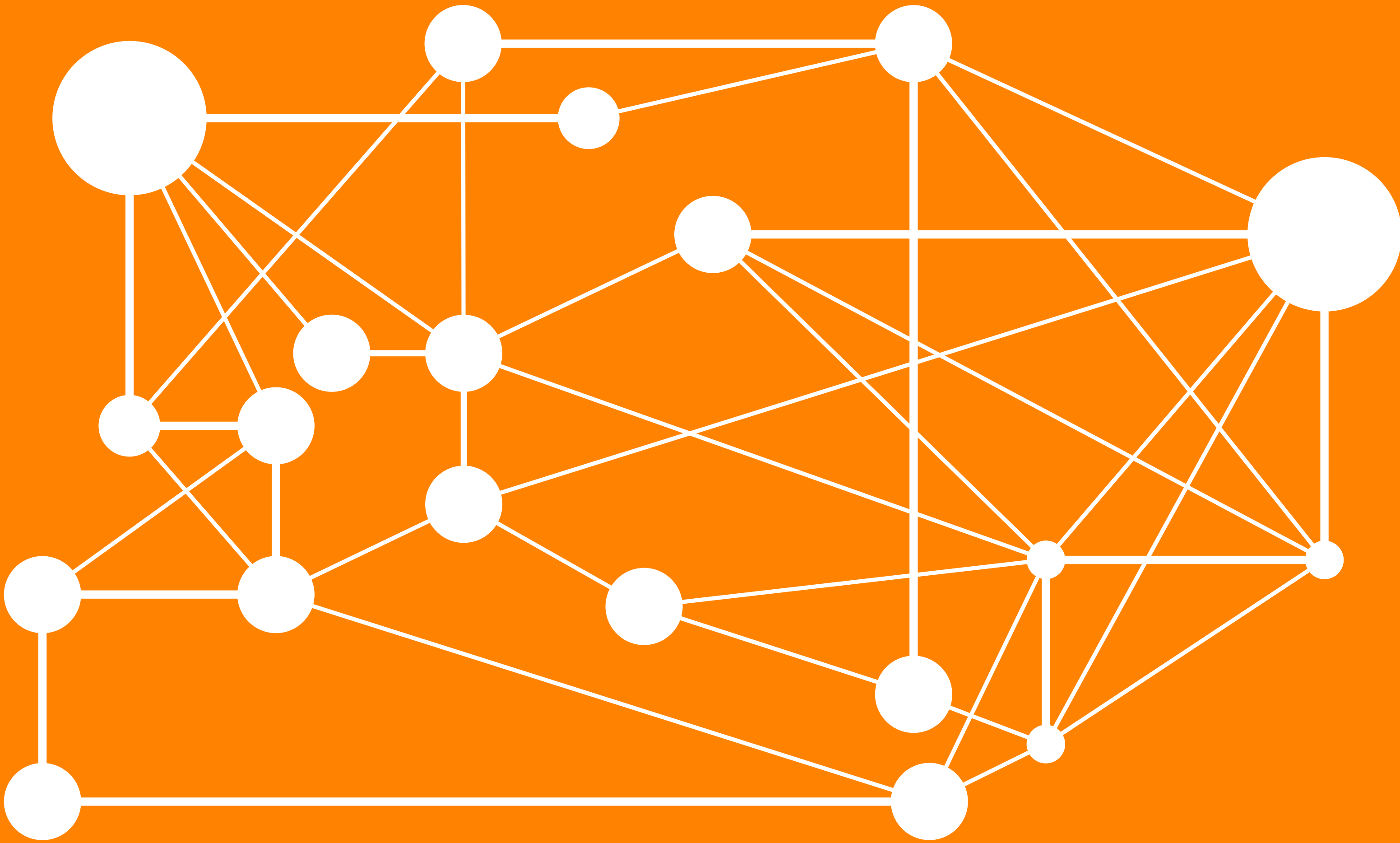
Source: Data of Derr for air dehydration with activated alumina (1938)

Business Impact

Relying on the answers and insights available in Knovel, Aldred designed a $4 million gas substation that uses a regenerative adsorbent. It achieves its target of producing an annual output of 1 metric ton of natural gas for local consumption.

His design provides efficient gas processing, saving the company substantial money in operating and maintenance costs. Because the operation uses a regenerative adsorbent, the substation is capable of running uninterrupted for a year without replacing the adsorbent. It has an affordable annual running cost of $100,000 in consumables. The unconventional design also fulfills other key considerations, including increased reliability for dependable remote operation and the integration of materials suitable for extreme cold temperatures.

The information the engineer found in Knovel also enabled him to discuss the relevant technology knowledgeably with vendors, improving their knowledge base and reducing the time needed for the design and build phases.



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