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# Making the world's largest ammonia plant even larger

In 2006, Saudi Arabian Fertilizer Company (SAFCO) started operating their fourth ammonia plant in the Al-Jubail industrial complex in Saudi Arabia. Back then, it was already by far the largest ammonia plant in the world with a capacity of 3,300 mtpd of ammonia. But SAFCO had more natural gas available than the plant was consuming. So SAFCO commissioned a revamp project to increase ammonia production – under strict boundary conditions.

SAFCO IV, the first plant in the world to utilize the uhde® dual-pressure ammonia process, had a record-breaking production capacity at its commissioning in 2006. In those days, a world-scale ammonia plant produced around 2,200 metric tons of ammonia per day (mtpd). SAFCO IV's nameplate capacity was 50% higher. But as the plant was consuming less than the total available amount of natural gas, SAFCO wanted to increase the plant's ammonia production to 3,670 mtpd in order to consume all the natural gas. But the boundary conditions were challenging: maintaining urea production at 3,600 mtpd; keeping energy consumption per ton of ammonia constant; ensuring the technology could cope with two very different gas compositions (high and low calorific value); and minimizing shutdown time.

The increase in capacity of the revamped plant was “only” 11.2%, but in absolute terms the targeted capacity was uniquely high. It was the first-ever revamp of an uhde® dual-pressure ammonia plant, and this relatively new plant had no high margin of unused overdesign that could have been turned into additional capacity. For this turnkey revamp project thyssenkrupp Industrial Solutions won the basic engineering contract in 2014 and during project execution supplied the proprietary equipment, training and commissioning advisory service to the South Korean company eTec who acted as the engineering and construction contractor.

The technical concept for the revamp was not fixed at the beginning of the project but was elaborated as part of the study with input from SAFCO and the thyssenkrupp team. The tk commissioning team Dr. Alexander Kleyensteiber, Maximilian Berger and Peter Sali evaluate the process:

„It was a positive experience to apply the proven revamp phase concept and execute the project in several phases from study via basic engineering to detail engineering – always with review meetings in between to allow for thorough evaluation of ideas and sound „decision-making“. The thyssenkrupp specialists emphasize that the revamp concept applied for SAFCO IV was a product of the “given circumstances of the project and that other options could have been selected under different boundary conditions”. Ultimately, the main modifications were carried out in the primary reformer, the low-temperature (LT) shift, CO<sub>2</sub> removal, and OT ammonia synthesis. All were delighted that the project was brought to a successful conclusion in 2018.

**“This successful revamp project not only increased ammonia production at SAFCO IV by 11.2%, it also had an excellent safety record with no lost-time incidents.”**

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Dr. Alexander Kleyensteiber, thyssenkrupp Industrial Solutions

SAFCO IV's ammonia capacity is now the world's highest at 3,760 mtpd. But just as importantly, all the boundary conditions for this turnkey project were fulfilled. The energy consumption per ton of ammonia was kept constant, as was the amount of urea produced. The shutdown was a mere 70 days, as erection work had already started before the plant was shut down and the first pre-commissioning took



place while construction was going on. Moreover, there were zero lost time incidents (LTIs) in a project that took 4 million man-hours. In making the world's largest ammonia plant even larger, thyssenkrupp again displayed its expertise and experience in successfully completing such large-scale turnkey projects.

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**The bottom line:** How do you make the world's largest ammonia plant even larger while maintaining energy consumption per metric ton of ammonia, leaving the overall urea output unchanged, and minimizing shutdown time? Call in thyssenkrupp. That is what the Saudi Arabian Fertilizer Company (SAFCO) did when its SAFCO IV plant needed a revamp to utilize all the available natural gas for ammonia production. The turnkey project was completed successfully and safely. SAFCO IV's world-leading nameplate capacity is now 3,670 mtpd and all the boundary conditions were met.

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