# A new dimension in ammonia production: Large-scale single-train plants based on proven technology

Before 2003, the world of ammonia production was very different from today. The standard world-scale capacity was only around 2,000-2,200 metric tons per day (mtpd) but the demand for ammonia was rising

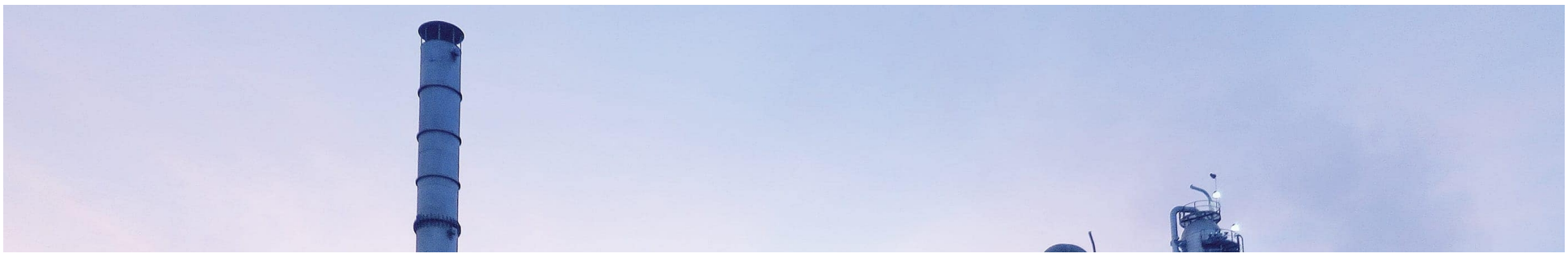
rapidly. Then in 2005, Uhde (now thyssenkrupp) presented a technical and economic feasibility study for a 4,000 mtpd single-train plant. This was the breakthrough the industry needed, and the trend to higher capacities has been unbroken ever since.

It was the uhde dual-pressure ammonia process that opened the door to production capacities of more than one million metric tons per year that the market was increasingly demanding. The trend to significantly higher capacities in single-train plants was driven not just by market forces but also by the economies of scale thyssenkrupp's large-scale plants made possible. These single-train plants based on proven technology reduced the production cost per metric ton of ammonia and were more reliable than multiple trains. However, there were some technical difficulties that first had to be overcome.

Prior to 2003, the problematic areas in scaling up existing equipment were syngas compression, synthesis piping and the refrigeration compressor. The beauty of the dual-pressure ammonia process is that it enables certain items of critical equipment to be built smaller than would be required when scaling up a conventional plant, thus minimizing the scale-up risk.

In the meantime, thyssenkrupp has engineered and constructed several large-scale single-train ammonia plants as proof of concept. The first newly built dual-pressure ammonia plant was SAFCO 4 in 2006, which was then the world's largest ammonia plant and a major milestone in ammonia production history. This plant's 3,300 mtpd capacity was based on a synthesis loop identical to a 2,200 mtpd plant and a once-through synthesis of approx. 1,100 mtpd. Since then, thyssenkrupp has delivered four new plants with a total capacity of 13,200 mtpd or 4.6 million metric tons a year, which amounts to nearly 3% of the world's ammonia production. A fifth plant is currently under construction.

Despite its success, the dual-pressure process also has a weak point, meaning that there is room for improvement: For the sake of risk-free scale up, it adds equipment to the standard process, mostly another ammonia converter and the cooling train associated to it. Hence, it does not fully exploit the potential of the economy of scale. Further savings are possible by deleting the additional equipment and integrating its function into that of the standard process. Therefore, thyssenkrupp has launched two R&D projects on this subject. Two technical innovations proved decisive: first, by deleting the once-through synthesis and correspondingly increasing the size of the synthesis loop, it was possible to design and construct a 3,300 mtpd plant featuring less equipment than required by the dual-pressure ammonia process; second, for capacities above 3,300 mtpd, the once-through synthesis could be added to enable a plant with up to 5,000 mtpd capacity. Such a plant is now available from thyssenkrupp as a one-stop-shop solution – engineering, procurement and construction (EPC) from a single source.



The bottom line: Over ten years ago, thyssenkrupp's dual-pressure ammonia process had opened the door to ammonia capacities of more than one million tons per year. Repeated projects of that size demonstrate that there is a market for such high production rates. Our large-scale single-train plants have taken ammonia production to a higher level to meet market demands for greater quantities and plant operators' need for cost per metric ton savings and greater reliability than is possible with multiple-train production. That technical breakthrough also serves the basis for ammonia plants with capacities up to 5,000 mtpd based on proven design and more than ten years' experience in operation and maintenance of thyssenkrupp's dual-pressure ammonia plants.