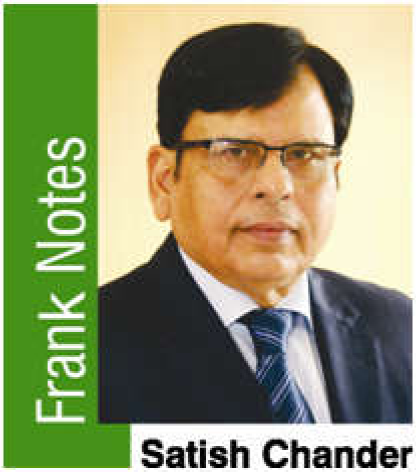

Innovations in Fertiliser Production

Production of fertilisers is capital- and energy-intensive process. It involves employment of very sophisticated technologies. The history of production of fertilisers in the country on large scale dates back to 1951. The initial phase of development witnessed construction of small plants of size 200-500 tonnes per day (MTPD) ammonia using a variety of feedstocks and raw materials. Size of ammonia plants increased in next 10-15 years to 600-900 MTPD. But there was use of unproven technologies and equipments due to paucity of foreign exchange. There was also emphasis on developing indigenous capabilities for manufacturing both high temperature and high pressure static equipments and moving machines in form of large compressors, turbines, pumps and fans. Employment of such an approach helped in development of indigenous capabilities but resulted in poor reliability of fertiliser plants.

In the next phase of development, there was emphasis on improving reliability and hence capacity utilization of plants. Availability of natural gas as feedstock and better technologies and equipment enabled the industry to construct large scale plants of size of 1350 MTPD ammonia and corresponding capacity for urea with very high reliability. Having installed a large number of plants and running these at high capacity continuously provided the confidence to the industry.

With ever increasing cost of energy and raw materials, the attention then shifted to improving operating efficiency of the plants. This became important not only from point of view of improving economics of production but also for reducing the footprint on environment.

There was continuous employment of new technologies, replacement of old and inefficient equipments, adoption of high degree of automation and most importantly the operation and maintenance staff were made aware of importance of energy efficiency and environment. These efforts resulted in significant improvement in operational efficiency. FAI is monitoring vital parameters of efficiency and environment for last several years. Efforts of the industry are reflected in very significant improvement in performance of all fertiliser plants.

The energy consumption for the ammonia plants has reduced from 12.48 Gcal/MT ammonia in 1987-88 to 8.45 Gcal/MT ammonia in 2014-15 and for urea plants from 8.87 Gcal/MT urea to 6.04 Gcal/MT during the same period. The weighted average specific consumption of ammonia in production of urea has reduced from 0.589 MT/MT in 1990-91 to 0.579 MT/MT in 2014-15 against the stoichiometry requirement of 0.567. Many plants are operating at specific consumption ratio of 0.570. In case of complex fertiliser plants, the raw material efficiency of nitrogen and P_2O_5 also increased from 93% and 94% in 1992-93 to 97.4% and 97.9% in 2014-15, respectively. The water consumption of ammonia and urea plants has been reduced by about 40% over last 25 years. The waste water discharge has been drastically brought down by almost 80% during the same period.

Having achieved a very high level of efficiency, comparable to best in the world, industry is not resting on its laurels. Industry continues to invest efforts and resources in innovations which bring about improvement, however, small these are. Only a few examples are cited here.

Effective utilisation of waste heat from process gas, flue gases and steam provide tremendous opportunity to improve efficiency of production. Process licensors designed the plant and integrated various sections to effectively utilise waste heat. However, there remained scope for utilisation of low level waste heat. A number of ammonia plants installed additional heat recovery coils and improved design of heat exchangers in flue gas duct to bring down the reformer stack temperature from more than 200 °C to 120-150 °C. The low level heat which was earlier wasted in cooling water is now being used in vapour absorption machines (VAM) to heat a low boiling solvent such as Lithium Bromide which produces a chilling effect. This cold is used to cool the process gas for compression. The lowering of temperature increases the efficiency of compression and also increases the capacity of compressor due to higher mass flow. A number of plants have implemented this scheme in process air, carbon dioxide and synthesis gas compressors.

Urea plants have been modified to improve the conversion efficiency of reactor by installing improved designed trays. In a recent revamp, one of the urea plants installed a Vortex mixer in the reactor to increase the conversion efficiency and reduce steam consumption. The efforts have been made to improve the quality of fertiliser products. In India, all urea plants operate Prilling Tower for finishing of fertilisers. Plants have installed acoustic system, vibro-priller or specially designed prill buckets to improve the quality of the prills as well as reduce dust emission.

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Complex fertiliser plants are almost 100% dependent on imported raw materials. Raw materials account for major part of cost of production. Therefore, improvement in raw material use efficiency is of utmost importance. These plants have undertaken modifications in granulator and pipe reactor systems to improve raw material efficiency. Schemes have also been implemented to utilise waste heat for heating air for drying of products thus reducing fuel consumption. A number of plants have also developed new products such as customized, fortified, water soluble and bio-fertilisers for better nutrient use efficiency and crop productivity. Research and Development work is also being carried out to develop nano-fertilisers.

The fertiliser plants have also given due emphasis on improvement in environment and have gone much beyond the statutory compliance. Conservation of water is one area where industry has used newer and newer technologies for waste water treatment and reuse. A number of plants have implemented schemes to utilise waste water from factory and domestic sources to completely recycle in the process and achieved zero discharge. Another example of improving environment is innovative use of by-product phosphogypsum generated during production of phosphoric acid. About 8.0 million MT of phosphogypsum is generated every year. A large quanity is sold to cement plants at nominal prices. Use of phosphogypsum in agriculture is also being promoted. Two plants have set up production units for manufacturing panels from phosphogypsum which are suitable for construction of multi-storey buildings. Yet another phosphoric acid plant converted an old phosphogypsum site into a green belt through bio-remediation.

FAI had instituted a Technical Innovation Award for schemes implemented in fertiliser plants which result in better process and procedures to reduce the costs, higher energy efficiency, higher reliability and safety; reduce environment impact and lead to import substitution. The award is to recognize implementation of original ideas for practical gains. The present issue of Indian Journal of Fertilisers is part of the effort to periodically document innovations implemented and benefits derived by various plants. These innovation can often be replicated and bring about change to produce fertilisers with least cost and least impact on environment. ■