



**Yara's well established Fluid Bed Granulation
now at
Uhde Fertilizer Technology**

by

**Paul Niehues, Roger Antonus
Uhde Fertilizer Technology bv
Roermond, The Netherlands**

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1. History of Yara Fertilizer Technology

Fluid bed granulation was first tested at Hydro/Yara's (then NSM) laboratory, as early as 1973. As a result of these promising tests, a semi-industrial pilot plant (SIPP) with a capacity of 150 mtpd was built to better define the process parameters and to prove the performance of this technology on a larger scale. This pilot plant, which was completely revamped in 1999, remains till today in operation in Sluiskil as a vital part of R & D activities related to fluid bed granulation.

The success was so encouraging that it was decided to build the first industrial plant in Sluiskil with a capacity of 800 mtpd. This plant started production in 1979.

Thereafter the license of this technology was offered to the fertilizer producers worldwide. The start up of the first licensed plant took place in 1983. Also in 1983 the contract for the first large capacity plant of 1500 mtpd was awarded. In the course of the following years the capacity increased gradually to 2000 mtpd and many licensed plants were built.

The integration of the licensing activities into the global Hydro/Yara organisation brought a first negative impact in 1995. At that time Yara restricted for the first time its licensing policy. The license was only available under certain commercial conditions.

The next few years the licensing policy was not very firm and strict: It changed from case to case, but most of the time the license was made available. So the capacities grow up further to 3600 mtpd as a single stream unit.

In 2004 Norsk Hydro separated its agriculture department business from the rest of the company: Hydro Agri became an independent listed company; the new name was Yara International. Immediately thereafter Yara decided to divest its urea granulation licensing business.

In 2005 Uhde Fertilizer Technology could acquire the exclusive world-wide license of the fluid bed granulation technology.



2. The Deal

Yara offered the fluid bed granulation technology to several companies in the fertilizer technology field and asked these potential customers for their best price. It was followed up with a long period of intensive discussions because this type of business was new for all parties involved: for Yara management, for the potential take-overs as well as for the lawyers from both sides. To sell and buy a technology turned out to be completely different from selling and buying a plant.

Finally, after a period of more than one year, Uhde became the successful bidder. The contract was awarded to ThyssenKrupp Nederland with date August 31 in 2005 and a new licensing company with the name Uhde Fertilizer Technology was established.

The new company, UFT in short, has the unlimited right to license world-wide the Yara fluid bed granulation technology under its own name. At the same time Yara stopped licensing fluid bed granulation technology for new plants.

UFT also acquired the complete Know How of this technology, all the experience and all references.

The ongoing license contracts remain with Yara until all contractual obligations and liabilities are accomplished. Thereafter UFT will take over those references as well. From then on, Yara stops completely its license activities of the fluid bed granulation technology indefinitely.

3. The New Company

In order to ensure a smooth transfer of all activities and to maintain the excellent quality, Yara provides to UFT some service.

Some very well experienced staff are working for UFT
Roger Antonus for licensing and sales
Joachim Körber for engineering
and Roland Monstrey for research and development, and for site assistance.

Furthermore the pilot plants in Sluiskil are available to UFT for their dedicated research and development activities.

Customer training and commissioning service is also still supplied by Yara.

Uhde Fertilizer Technology has a very simple but firm licensing policy: as an independent company registered in the Netherlands it will carry on the well established licensing activities from YFT on the same basis, however without any restriction whatsoever .

UFT takes also care of after sale services for all reference plants, also those built by Yara. This service includes supply of spare parts, trouble shooting and revamp studies.

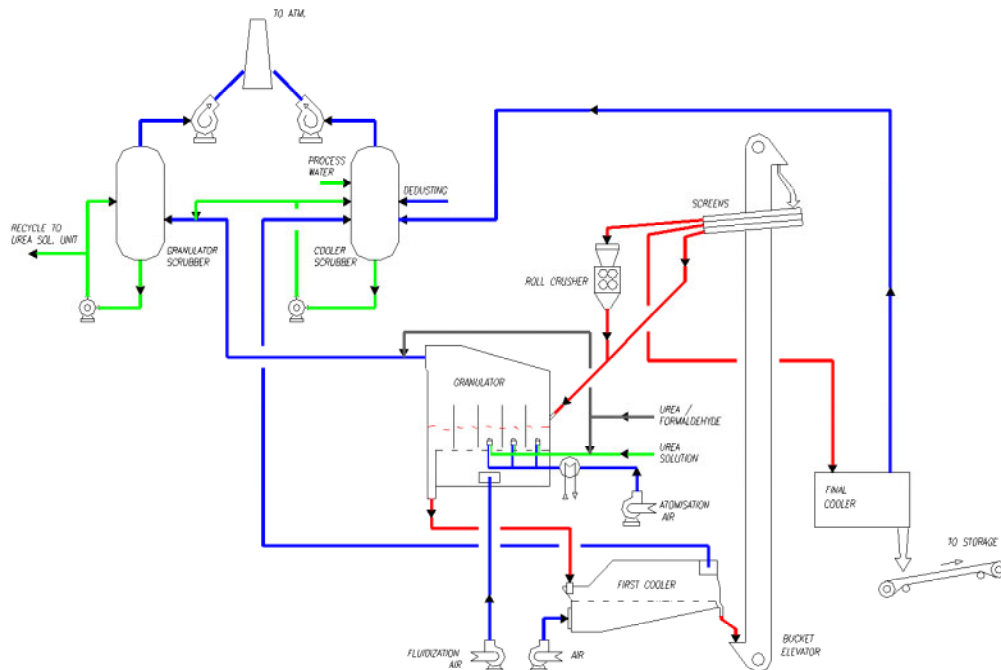
The company is located in Roermond in the Netherlands. Roermond is located centrally between Dortmund, Sluiskil and Brussels.



Figure 1: Locations

4. The Technology

The technology is the well know Yara fluid bed granulation technology as shown in the flow diagram.





This technology guarantees the production of excellent granular urea which is world-wide distributed and honoured by dealers and farmers all over the world.

The feed stock of the granulator is a urea solution with a concentration of only 96%, which offers several advantages.

- 1) The evaporation of the remaining water removes most of the crystallisation heat already and hence less crystallisation heat has to be removed via air which minimises investment in air system and power consumption for the fans.
- 2) A concentration of 96% can be achieved in a single evaporation step; this contributes to lower investment, less steam consumption and easier operation of the synthesis part.
- 3) A concentration of 96% generates remarkable less process condensate which again contributes to lower investment and less steam consumption in the water treatment system (desorber/ hydrolyzer). Not only the water from the urea solution but also the condensed steam from the vacuum injectors are contributing.
- 4) Moreover low biuret can be achieved only with low concentration of the urea feed-stock.

The ammonia in the off gas is defined by the free ammonia content in the urea melt; without any special treatment all the free ammonia is stripped in the granulator and discharged to the atmosphere. This ammonia can be reduced partly by incorporation of the patented ammonia abatement system via injection of formaldehyde in the granulator exhaust air. However only the application of an acidic scrubbing system removes nearly all ammonia from the granulator exhaust. Both systems are proven and can be applied.

5. The Reference Situation

There are about 50 reference plants in operation or under construction all over the world. They operate in very different and severe climatic conditions, ranging from extremely hot (plus 50°C in Saudi Arabia) down to freezingly cold (minus 40°C in Canada). The total annual capacity is about hundred thousand metric tonnes.

Also the capacities cover a wide range, from 500 mtpd up to 3600 mtpd, all as single stream units.

Today more than 80 % of granular urea produced by fluid bed granulation originates from the UFT fluid bed granulation process plants.



Figure 2: UFT Fluid Bed Granulation – Plants throughout the World

6. The Pilot Plants

UFT has also access to the pilot plant at Yara Sluiskil. There are 4 different test options possible. At first 2 small batch type granulators available for principle tests with regard to fluidisation and granulation. If these tests are successful the next step is a continuous small test plant, with already a complete solid recycle loop system. Urea to be sprayed into the granulator will be generated by melting urea granules. By those tests the granulation behaviour can be tested more thoroughly. If these tests are successful the real test can start in the semi industrial pilot plant, the so called SIPP Unit. This is a plant which operates under real industrial conditions. All equipment of a complete granulation unit and a separate evaporation loop is installed and there is lots of space that make modifications easy. The original SIPP was installed in 1975 to develop at that time the original technology. In 1999 the SIPP was completely revamped and nearly all equipment were renewed. The SIPP can produce 150 mtpd, with fresh urea solution from the existing industrial synthesis plant. In case required the concentration can be controlled in a dedicated evaporation unit. The granulated product is sent to the normal storage. This unit can run for long production periods, so the tests will reflect real industrial operating conditions and a realistic plant situation.

This SIPP is a real valuable pilot plant. All new ideas will be tested under industrial conditions before they will be applied in an industrial plant. Or if there problems occur in a industrial plant, they can be simulated to a great extent in the SIPP, in order to evaluate the possible shortcomings and remedies.

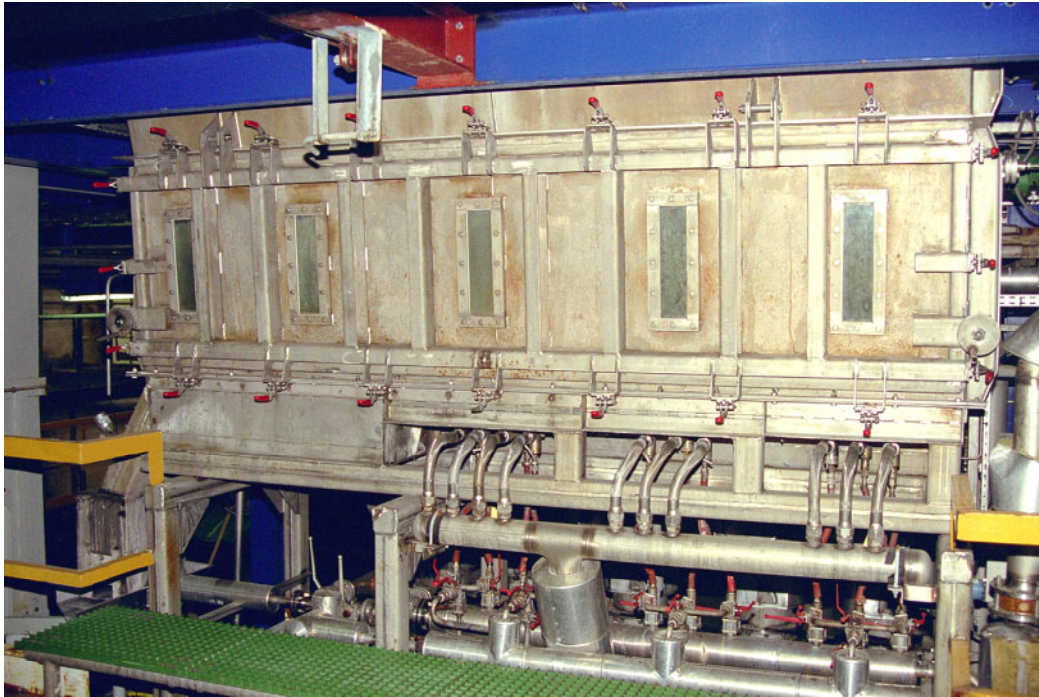


Figure 3: Granulator of the Semi Industrial Pilot Plant



Figure 4: Overview of the Semi Industrial Pilot Plant



7. Our Contractors

UFT is a licensing company and does not act as an engineering contractor; it grants the licence, prepares the process design package and supplies the proprietary equipment, the lower part of the granulator, as a pre-assembled unit, and provides site assistance for commissioning and performance test activities.

UFT grants the license generally to those contractors active in the fertilizer plant (ammonia / urea) business. Our main contractors are Chiyoda Corp. in Japan, Kellogg Brown & Root Inc. in USA, Mitsubishi Heavy Industries Ltd in Japan, M.W: Kellogg Ltd in Great Britain, Snamprogetti S.p.A. in Italy, Tecnimont S.p.A. in Italy and Uhde GmbH in Germany. On a case by case basis as requested by the client, other reputable contractors can be taken into consideration.

UFT's definitive philosophy is to treat all contractors in exactly the same manner.

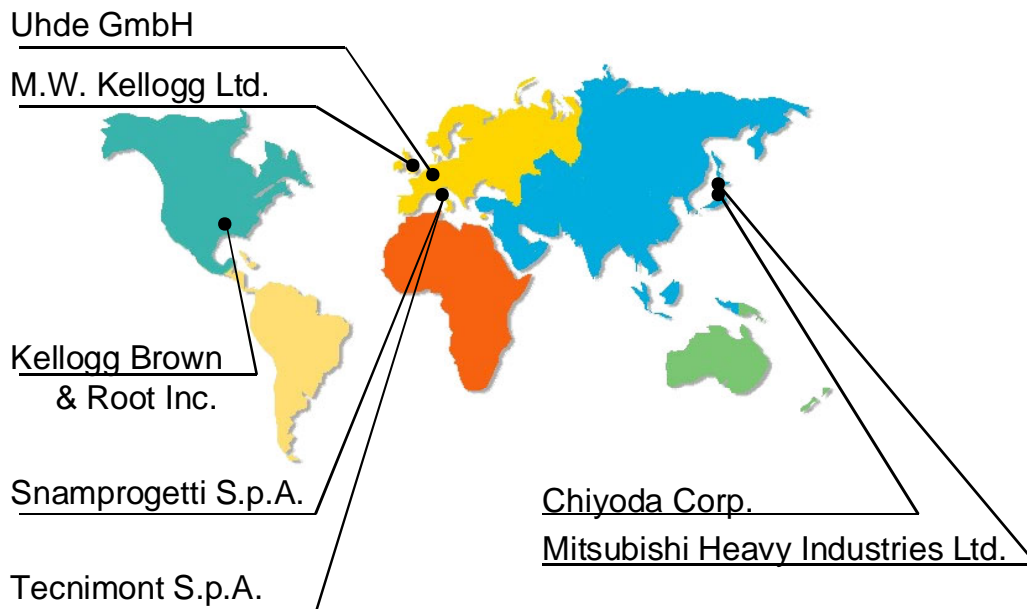


Figure 5: Main Contractors