

Drastic reduction in CAPEX and OPEX in Urea Granulation Plants

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Summary

Green Granulation Technology (GGT) is a leading provider of fertilizer related process technologies, offering urea granulation and other fertilizer-related technologies. It is also the owner and developer of the state-of-the art Cold Recycle Fluid-Bed Urea Granulation Technology (CRG) process. The first CRG process was successfully applied in one of GGT's projects in China in 2013 (3000MTPD). Since then, over 11.000MT of daily capacity are under construction of which 1000MTPD has is being commissioned today.

The Cold Recycle Granulation (CRG) process is modernizing the Urea Granulation world. This is state-of-the-art Granulation Technology, where energy saving, low investment costs and high product quality are combined in a ground shaking new layout and a revolutionary production process.

GGT introduces the CRG process and present its characteristics and advantages.

CONTENT:

- Presentation of the CRG Process
- Features of the CRG Process
- Energy consumption
 - low fluid bed level resulting in less heating of the fluidization air fan and consequently reduced amount of needed air, especially for the Cooler.
 - hydraulic urea solution sprayers use reduced amount and lower pressure of atomization air
 - low pressure drop scrubbers reduce the power consumption of the exhaust air fan(s)
 - reduced amount of urea dust to recover, combined with higher urea content of the recovered urea solution, due to low atomization air. Higher granulator scrubber temperature and the use of scrubbers that can eventually handle insoluble in the scrubber liquid.
 - smoothening the airflow within the plant by optimizing the ducting
- Investment
 - low building height, typically 27m total height (reduced investment and easy access for operators)
 - low requested building strength; highest load bearing floor is at the granulator bottom at 17m; vibrating screens are located below the granulator
 - reduced granulator and cooler strength because of low fluidization air fan pressure and low scrubber exhaust fan suction vacuum
 - bucket elevator capacity is only 30% of standard; lifts only fines and crushed product
 - reduced air ducting; air enters the scrubbers from the top and leaves the scrubbers from the side
- Product quality
 - low product moisture due to the combination of the GGT hydraulic sprayers and GGT sprayer layout
 - optimized internal dynamics in the fluid bed

- Granulator and Cooler in-line, operating at the same bed layer thickness lead to slow cooling and reduced product dustiness thanks to the surface treatment in the bed.

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1. INTRODUCTION

Green Granulation Technology (GGT) is a leading provider of fertilizer related process technologies, offering urea granulation and other fertilizer-related technologies. It is also the owner and developer of the state-of-the art Cold Recycle Fluid-Bed Urea Granulation Technology (CRG) process. The CRG process was successfully applied in one of GGT's projects in China in 2013 (3000MTPD) and 2014 (1000MTPD). The Cold Recycle Granulation (CRG) process is modernizing the Urea Granulation world. This is state-of-the-art Granulation Technology, where energy saving, low investment costs and high product quality are combined in a ground shaking new layout and a revolutionary production process.

2. COLD RECYCLE GRANULATION PROCESS

GGT has developed a revolutionary new Urea Granulation process that has been baptized "Cold Recycle Granulation" or in short CRG Process. The essence of this process lies in handling the cooling in one single step so that screening, crushing and recycling is with cold product. This way, screens and crushers are kept clean for longer time and less dust is produced during those processes. The CRG process has reduced the investment and operational costs of Urea Granulation and at the same time optimized product quality and reduced dust emissions.

2.1 Construction related investments

2.1.1. Height of the building

GGT has complete reworked the traditional idea of the layout of a Urea Granulation Unit, resulting in a much lower building that offers convenient access to the operators. Not only does that make the construction much cheaper, it also allows operators to move more quickly and efficiently throughout the plant

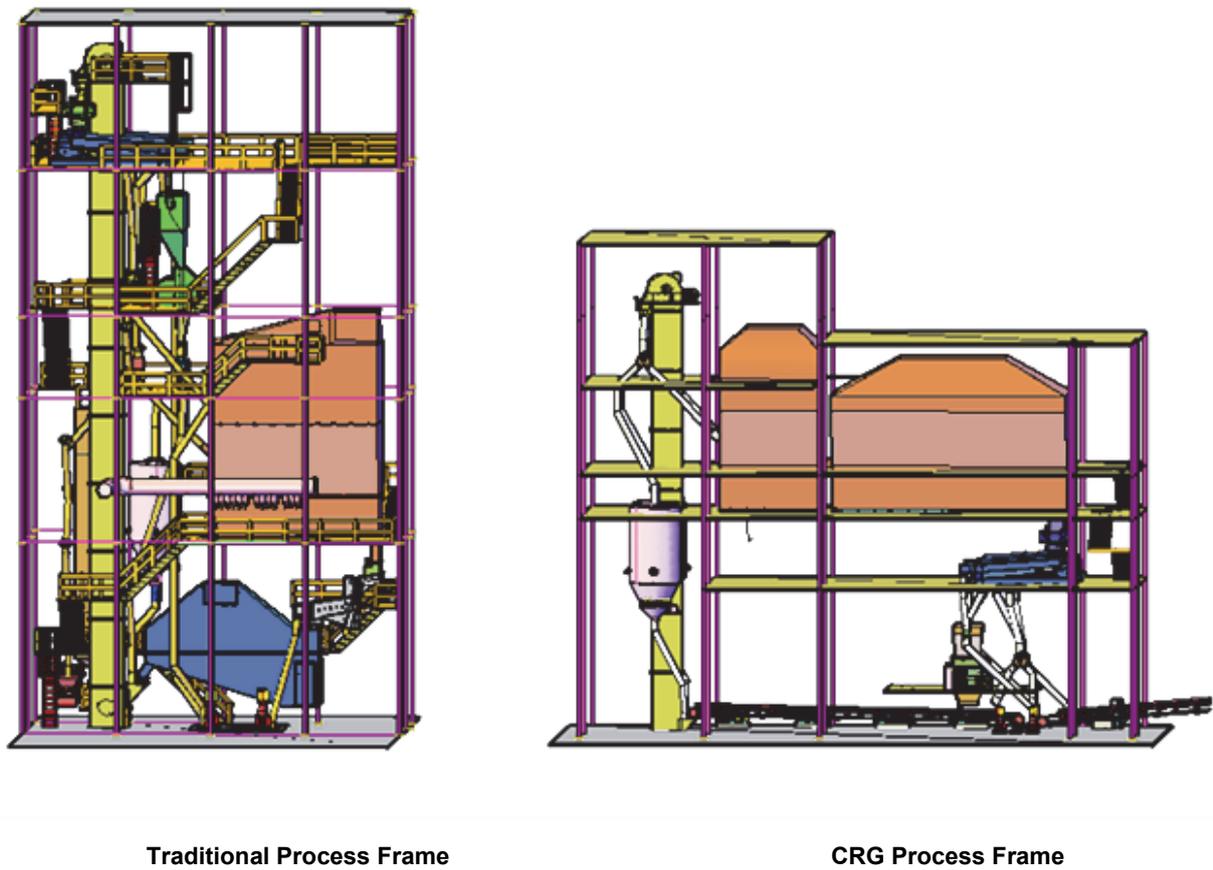


Fig. 1: Building height

The most drastic saving in height comes from the use of one single Cooler that is in-line with the Granulator.

The Cooler automatically operates at the same bed-level of the Granulator. This last one has no cooling compartments, only injection compartments. This makes that the product is entering the Cooler at 108°C. Cooler outlet temperature is according desire of the client. Since the Cooler is operating at a relatively high bed level, the CRG process obtains a maximal polishing effect in the Cooler.

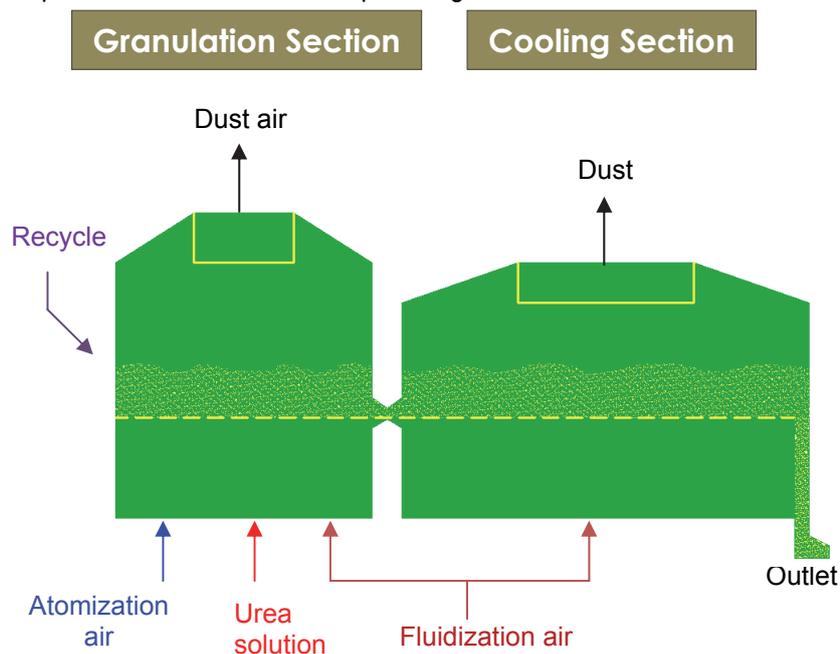


Fig. 2: Granulator and cooler in-line

The single cooler is handling all cooling, down to product end-temperature, so screening of the product and crushing of the oversize granules is done on cold product.

GGT has combined the screen feeder and safety screen in one-single apparatus. This is leading to a considerable saving in height, but is only possible thanks to the site layout with screens downstairs the Granulator/Cooler, since the safety screen is normally located upstream the bucket elevator.

Diverters are traditionally taking a lot of height, especially the additional diverters for forestry size. GGT is able to control the Granulator seeding for big size, eliminating the need for this diverter. During design, GGT has spent a lot of time and effort in minimizing the required height for the diverters, without compromising on the free flow through the device.

2.1.2. Strength of the building

In the CRG process, the vibrating screens and crusher(s) are located below the Granulator/Cooler. Screens with horizontal gyratory screening movement and also other types of vibrating screens are very demanding when it comes to the required strength of the building. A building has to be designed and constructed in such a way that it not only can withstand the weight of the different components, but also the rotating vibrations that some of the equipment is producing. This implies that, for a urea granulation building, one should take into account the harmonic vibration of all (2, 4 or even 6) vibrating screens, when calculating the strength and stiffness of the building. The laws of physics prescribe that a tall building with a strong source of vibrations in the top must be much stronger than a low building with the source of vibrations located in the lower part. By locating the vibrating screens directly below the granulator/cooler, GGT is reducing the need for a building that is extremely strong up to the top.

In addition to that, GGT has opted to locate the scrubber on the ground using an integrated scrubber circulation tank. There is basically no need for an underground tank.

2.2. Up-Stream related investments

The CRG process is using a urea melt feed of 95-96% (at the sprayers). Therefore, there is no need for a 2nd evaporation section in the urea synthesis plant. Not only does this mean a saving in construction costs, but it also leads to a saving in power consumption due to the high water content of the melt. *Table 1* shows the effect of water content in the urea melt feed on the Heat Balance of a Urea Granulation.

Water content in the Urea Feed Solution	Heat removed by evaporation
0% (100% urea solution)	0%
1.5% (98.5% urea solution)	10%
3% (97% urea solution)	22%
4% (96% urea solution)	35%
5% (95% urea solution)	40%

2.3. Power Consumption

2.3.1. Optimized internal dynamics in the fluid bed

For all Granulators it is vital to insure proper flow of particles towards the sprayers. One solution is to use a thick bed layer (starting from 600mm WC pressure drop over bed and perforated plate). Such a thick fluid bed is actually a “bubbling bed”. This means that small air bubbles are formed at the perforated plate and while rising, these bubbles grow in size until they explode when reaching the surface of the bed. It is this bubbling phenomenon that ensures a wild but uncontrolled movement in the bed and the product transport to the sprayers. This solution comes at a price, namely high fluidization air pressure, since it only becomes

effective from at least 600mmWC pressure drop. If no other aid for circulation inside the bed is provided, this movement by bubbling is absolutely vital for a thick layer fluid bed. If no bubbling is obtained because of lack of air or bed thickness, the moisture of the end-product will automatically be high.

GGT has developed and patented technology which implies a fluid bed granulator in which the sprayer arrangement involves spraying zones and drying zones. Seed material is sucked towards the spray zone by the combined upwards action of atomization and fluidization air. During the pass through the spray area they can grow by the sprayed-on urea melt. Once passed through the spray zone, the granule/seed will automatically flow into the still zone where the sprayed-on solution is given time to further evaporate while the granule/seed is sinking down for another pass through a spray zone. By optimizing the movement in the bed in this way, the different spray zones are able to handle much more product, without overloading the spray zone which would lead to higher moisture. The principal of optimized movement in the bed has allowed GGT to lower the bed level of the fluidized layer down to 450mm WC instead of the earlier mentioned +600mmWC. This optimization in combination with good spraying conditions has greatly reduced the need for residence time in the granulator.

2.3.2. Deep vacuum in the granulator

The lowered bed in combination with the low pressure drop scrubbers has made it possible for GGT to design a Urea Granulation Plant without fluidization air fan(s). The whole system (Granulator and Cooler) is operated under deep vacuum, pulling air through the system by means of the exhaust fan only. Not only does this eliminate the fluidization air fan (and its heating of the air stream), it also creates a deep vacuum in the granulation section which enables better evaporation during the spraying of the Urea Melt.

Since GGT has placed the Cooler on the same level of the Granulator, with the same bed level as the Granulator, also the Cooler can benefit from the deep vacuum. For the Cooler, the effect is even stronger. The Cooler is directly getting ambient air, since there is no fluidization air fan that is firstly heating the air with 6-9°C (or even more), resulting in more efficient cooling and reduced amount of cooling air.

If a fluidization fan is required, e.g. in case of the use of a Chiller on the last part of the Cooler or due to ambient design conditions, GGT uses a low pressure fluidization air fan with 300mm WC or less pressure, that is heating up the air no more than 3°C. The purpose of this fan is to compensate for the pressure drop caused by the chiller. The heating of the fan can help to dry out the chilled air.

2.3.3. Patented double temperature scrubbing system

The deep vacuum system is most attractive when the pressure drop over ducting, Granulator/Cooler and scrubbers is limited to a minimum. Therefore, GGT has designed and patented the double temperature scrubbing system involving low pressure drop horizontal type scrubbers that are able to capture very fine dust particles by condensation of water on the dust particles.

The double temperature scrubbing process can only be realized by using 2 separate scrubbers, 1 for the Granulator, 1 for the Cooler.

The low pressure-drop over the system is made possible thanks to the use of **Blu^e Fil** high efficiency mist eliminators by Mistrix. The close cooperation between GGT and Mistrix enables both parties to exchange knowledge and technology and offer a scrubbing system that has combined maximal efficiency with minimal pressure drop.

The Blu^e Fil technology enables a low pressure drop and a high efficiency since all the monofilaments are arranged at rectangular angles to the air flow to achieve the best possible separation of droplets. This unique weave stands in stark contrast to the random orientation of a wire knitted mesh.



Fig. 3: Blu^o fil mist eliminators by Benvitec

2.3.4. Optimizing ducting

GGT has put a lot of effort in optimizing the ducting throughout the Urea Granulation plant. Every turn or bend in an air duct is causing pressure drop and may cause turbulence in the air flow. By eliminating turns where possible and limiting ducting to a minimum, we easily save over 100mmWC pressure drop.

2.3.5. High performance hydraulic urea melt sprayers

The in-house developed GGT Mark II hydraulic sprayer has a working pressure of 4Barg. This air-assisted urea melt sprayer has been developed during semi-industrial pilot plant tests, with the aim of lowering the atomisation air pressure to 0.3Barg. This goal has been reached and the sprayers are now being installed in full scale industrial units. The GGT liquid sprayer is producing low moisture product due to the fine atomisation of the liquid, leading to very fast and efficient evaporation of the water.

The GGT Mark II sprayer not only produces very fine and homogenous droplets, but is also able to form seeds as a feed for the process in a controlled way. This seed formation can be controlled by regulating the pressure of the atomization air, header per header.

This seed creation is leading to lower load to the crushers. In the CRG process, the crusher capacity is only half the capacity of other types of Granulation Units. If needed for maintenance reasons, the crusher(s) can even be bypassed.

2.3.6. Flexibility by optional components

GGT offers the possibility to incorporate alternative cooling means to boost the cooling capacity of the Fluid bed cooler. As such, there is the possibility to add water cooled Cooling Plates in the fluid bed. These can be taken out of commission when ambient conditions do not require additional cooling.

The Cooling Plates make use of the plants cooling water circuit to boost the cooling of one or more compartments in the fluid bed Cooler.

The AirSieve technology is able to extract a stream of fine material from the side of the Cooler, at a location where the product has not yet been cooled down to end temperature. This stream is directly recycled in the stream of fines and crushed product to the Granulator.

3. CONCLUSIONS

Putting the Granulator and Cooler on the same level has drastically reduced the heights of the Granulator plant building. The location of the vibrating screens highly reduce the need for a very strong building over the full height. The Optimized internal dynamics and the high performance liquid sprayers make the low bed level possible. That low bed level in combination with the low pressure drop scrubber system, and the

in line Granulator and Cooler make it possible to operate the system under deep vacuum without the need for a fluidization air fan.

Today, GGT is market leader in China and is ready to go international.