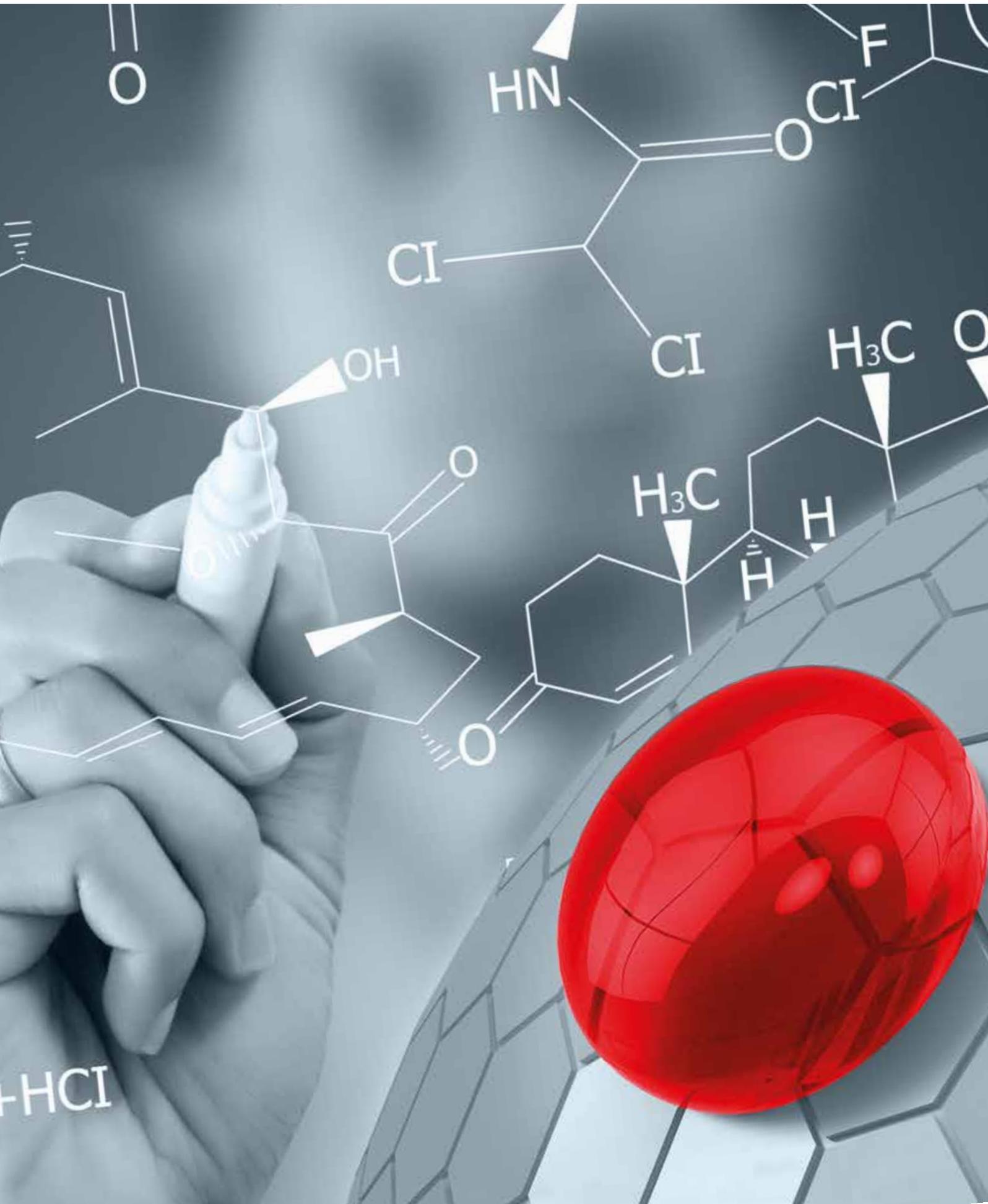


APPTec - ADVANCED PULSE POWDER TECHNOLOGY



THE NEXT GENERATION OF POWDERS

The globally increasing requirements for the functionality and service life of components, devices and appliances lead to constantly new challenges in material development across the entire value-adding chain. Greater functionality and extraordinary performance can be realized with high-performance powders generated by our APPtec.

Develop a high-performance powder with us that is precisely tailored to YOUR application!

APPtec stands for **A**dvanced **P**ulse **P**owder **t**echnology and allows you to control the product properties of new types of powder through specific settings that impact or change the particle structure, particle composition or particle surface properties.

Custom-tailored products with a wide range of applications and great economic potential can be manufactured in this manner or even new application sectors can be tapped or developed.

Be ready to deliver immediately after product development!

We have production capacity available for producing your target products. This service allows you to deliver quality products to your clients and secure key market opportunities with this speedy and effective strategy.

Do you prefer to produce on your own? No problem, we can design, deliver and build your specific production facility and assist you with our engineering services, even establish a completely new factory. Worldwide!

Take advantage of our potential for material design!

Material design is our competence in developing innovative powder systems specifically for high-performance applications, with functionalization and conversion to ready-to-use processing formats.

Our innovative technologies allow material properties to be precisely set according to your specifications. They even allow us to furnish particles with combinations of properties previously not available.

We offer the equipment for your development coupled with supporting know-how for each process step from powder synthesis to ready-to-use dispersion or high-performance granulate. We strongly focus on technical feasibility and the transfer to industrial production. Our technology center features installations for small-scale technical trials as well as test productions.

We are the ideal partner for the development, manufacturing, processing and application of complex particle systems. We will be glad to modify your material systems to allow simple integration in the product matrix.

APPtec to design YOUR material.

Advanced high performance requires exceptional solutions. Our APPtec beats at a tact of up to 300 Hz and enables the realization of previously unachieved quality in powder technology.

APPTEC FOR YOUR MATERIAL INNOVATION

Despite major innovations in the past few years, today's powder producers are specialized in a narrow range of materials. The available standard products often limit the performance of the specific applications. A customer-specific solution, which is required for high-performance materials is often not available.



The ProAPP in small technical scale for tests

Unique technology for YOUR innovative materials.

Our innovative APPtec allows material properties to be set precisely, exactly according to your specifications. This even allows you to configure particles with combinations of previously unattainable properties.

Customize YOUR required powder!

Secure a reliable supply source for materials exactly tailored to your application. Gain a competitive advantage through extraordinary functionality.

The thermodynamic conditions of our APPtec are exceptional and create targeted high-performance powders with advanced properties.

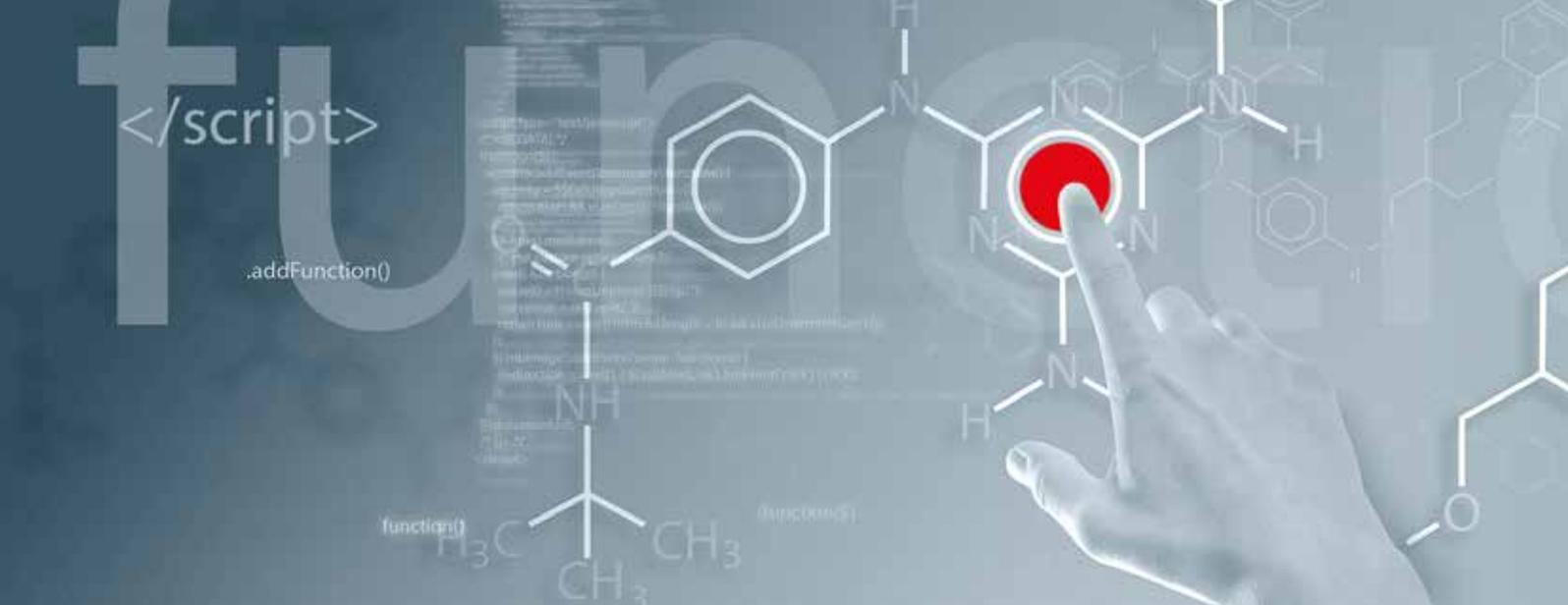
The chemical composition of the produced particles can almost be freely selected; doped or complex stoichiometrical materials as well as coated particles can be produced.

APPtec is a technology that is available on an industrial scale, and its aptitude for particle formation is well proven. This allows you to save time from the idea to the market entry of your new products.

ProAPP, the synthesis reactor using APPtec, is available in different sizes for development and production on a scale of tons.

We also provide R&D service and contract manufacturing to design and produce your material, or we can engineer and supply the technical equipment for your own production.

Do you want us to granulate your material? As experts in granulation, coating and pelletizing with over 60 years of experience, we have set the technology standards in this field.

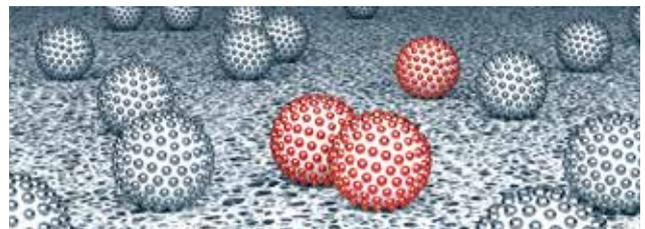


Discover the potential of materials with additional functions and improved properties!

The development and manufacturing of advanced powders with the qualities required for high-performance applications presents major challenges at every process stage. In order to assure absolute quality and reliability, we consolidate the entire spectrum of plant construction and production know-how under one roof. Some examples that we are working on:

Catalysts

APPtec enables a precise design of the surface properties with an extremely high activity as the basic requirement for effective catalysts.



Ceramics

APPtec allows the manufacturing of a new generation of high-performance ceramic powders with exactly customized composition or required doping elements.



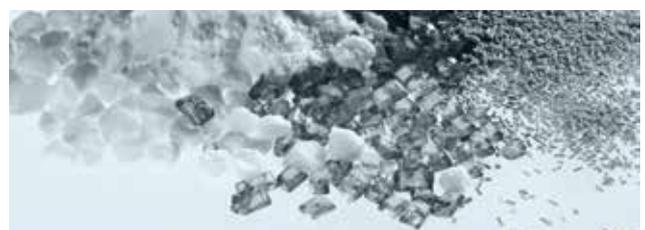
Pigments

Our high-performance inorganic pigments combine technical performance, economy and ecology (environmental and toxicological safety).



Food ingredients

Our products meet the highest demands for quality. The production is in accordance with the highest manufacturing standard as well as strict quality controls.



UNIQUE TECHNOLOGY

Today, innovative materials are of great interest in almost all industries. A very high economic potential is created with custom-tailored particle systems. New areas of application can be tapped or developed as well. However, new materials require innovative technologies which are often not available.



The ProAPP 500 for generating specialized high-performance powders with advanced properties

Set-up parameters

- » Homogeneous process temperature from 200 °C - 900 °C
- » Homogeneous and defined residence time from 100 ms - 10 s
- » Adjustable processing gas atmosphere oxidizing or O₂-free
- » Raw materials: liquids, suspensions or solids



Precursors are sprayed into the pulse gas stream



Manufacture YOUR powder with defined properties together with us!

APPt^{ec} is a continuous and exclusive thermal process for producing high-performance powders.

The specifically engineered combustion chamber is the core of the ProAPP. A pulsing hot gas flow is generated there in which the particles are produced and treated. The pulsing gas flow creates special thermodynamic reaction conditions that provide powders with superior properties. The pulsing gas stream is adjustable in frequency, amplitude, temperature and flow rate via the burner operation mode.

The synthesis reactor ProAPP is constructed in such a way that the pulsation only takes place in the gas stream, where it can be precisely controlled. The reactor is free of pulsation and very safe.

Because of the high degree of turbulence, pulsating gas flows do not exhibit any of the temperature and velocity gradients that are typical for continuous gas flows. All particles in the pulsating gas flow are subject to the identical temperature and dwell-time treatment as the basic prerequisite for homogeneous powder materials.

A precursor solution is sprayed into the pulse gas with an adjustable droplet size distribution. As a result of the defined thermal treatment, desired chemical and mineralogical reactions take place, particles are formed, and the conversion is stopped at the right moment.

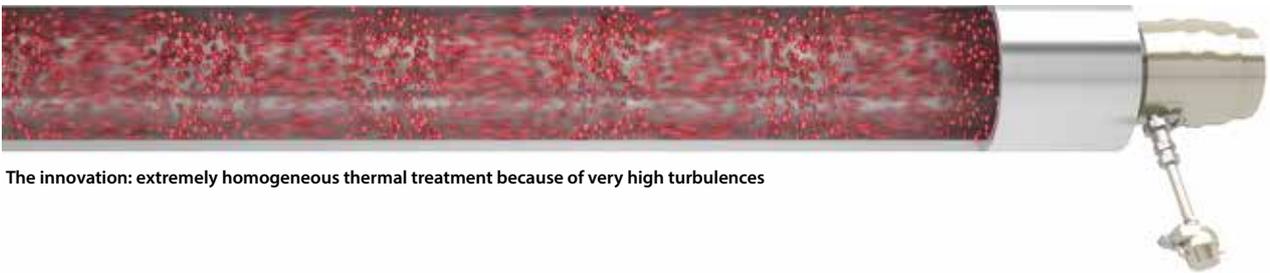
The thermal treatment can be faster than one second and up to ten seconds on demand.

Key facts

- » A continuous process to produce powders with fine and customized particles as well as defined and strictly reproducible process conditions.
- » Extremely homogeneous thermal treatment without temperature or residence-time gradients.
- » Unique processing options, e.g. powder synthesis, heat treatment, coating, activation, drying, as a single process or combined in only one process unit.
- » Possibility of precisely adjusting the gas stream and wide parameter range for the targeted treatment of many different materials.

ADVANTAGES FOR YOUR MATERIALS

Materials determine our environment and our world. They are key drivers behind almost all major technological advances and breakthroughs. Technological advances require innovations aimed at developing and manufacturing materials that are customized for desired performance requirements and applications.



The innovation: extremely homogeneous thermal treatment because of very high turbulences

Enhance the performance of YOUR materials by our APPtec!

A pulsating gas stream does not show a temperature or residence time gradient; it is completely homogeneous. Therefore, all particles experience the same treatment and process parameters, which leads to very homogeneous powders.

This technology can prevent hard aggregation because the temperature is strictly controllable and can be adjusted below the critical point to form a partly melting phase like with other thermal reactors.

The heat transfer from the gas to the particle is up to five times higher because of the pulse gas stream. The particle formation and phase reaction therefore runs much faster and creates an advanced crystal structure.

The exceptional thermodynamic conditions create advanced powder properties and allow the exact configuration of particles with combinations of properties or the addition of new functions.

The use of our APPtec is highly efficient, because of the combination of different processes in one step, e.g. drying and calcination or particle formation and coating.

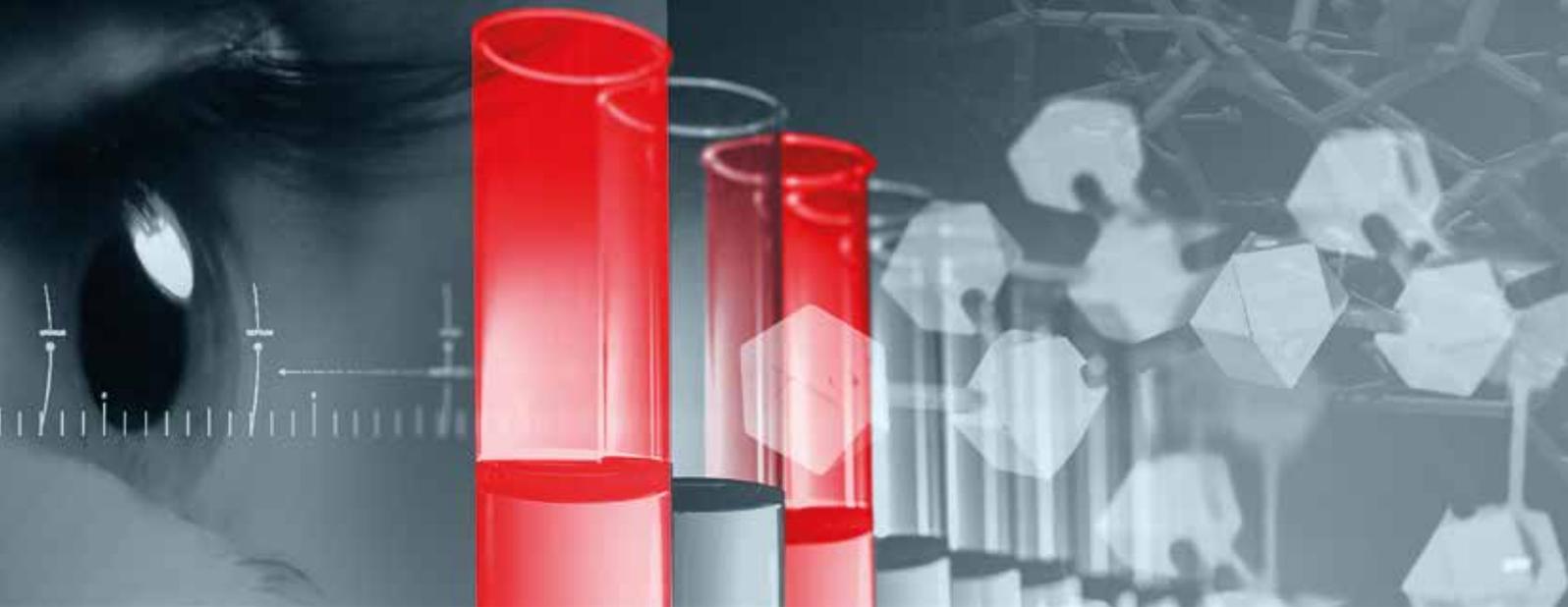
The process can be scaled customer-specifically. Based on years of experience, the successful test results can be technically transferred to a production. There is no long scale-up process.

The innovative APPtec for YOUR new high-performance materials!

Our powder synthesis process allows us to specifically generate the desired particle properties and integrate initial functionalities.

Benefit from the advantages of our powder technology for specifically designing your desired material properties.

Develop technological solutions together with us to create innovative and improved material structures combined with a cost-efficient manufacturing process.



Set the material properties precisely for YOUR application!

Utilize our extraordinary, exclusive APPtec and our know-how for the exact design of material structures. Our capabilities allow you to control the product properties of solids through specific settings, impacting or changing the particle structure, particle composition as well as particle surface properties. This will provide you with solutions for the increasing requirements for the handling, functionality and complexity of your materials.



Whether single oxides, doped materials or complex mixed oxides

Chemical composition - nearly free selection

- » The chemical composition is freely adjustable by using a liquid raw mixture
- » Single or doped oxides, very complex mixed oxides

Phase composition - adjustable

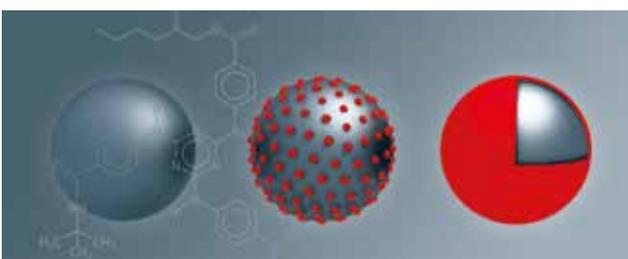
- » Adjustable with process parameters
- » Also high temperature phases such as Corundum or mixed oxides such as Spinal or Mullite



A freely selectable particle size with narrow size distribution

Particle size & surface - definable

- » From nano to micro
- » Advanced narrow size distribution
- » Precisely adapted surface characteristics



Functionalization of the powder particles

Spherical morphology – also in sub- μ

- » Spherical particles result from the type of material feeding (atomization of liquid raw materials)

Coatings & core-shell – a possibility

- » Customized core-shell particles possible
- » Defined layer thickness, porosity and activity

OUR OFFER: APPLICATION-SPECIFIC

The particle size of high-performance powder materials is often very fine or even on the nano scale. This is always accompanied by an undesired agglomeration in the powder form. However, high-performance powder systems only unfold their properties in the dispersed state.

Transfer YOUR materials into a suspension or granular form that can be easily processed!

We offer the right equipment coupled with supporting know-how for each process step from powder synthesis to the ready-to-use dispersion or high-performance granules.

Advanced powders

- » Advanced technology for advanced powders
- » Secure source by reliable contract manufacture and/or by implementation of your own process line



The exact targeted setting of material properties

Stable suspensions

- » Ready to use or suitable to granulate
- » Bead mill systems and analytical equipment for tests and contract manufacturing available



Technology and know-how for dispersion

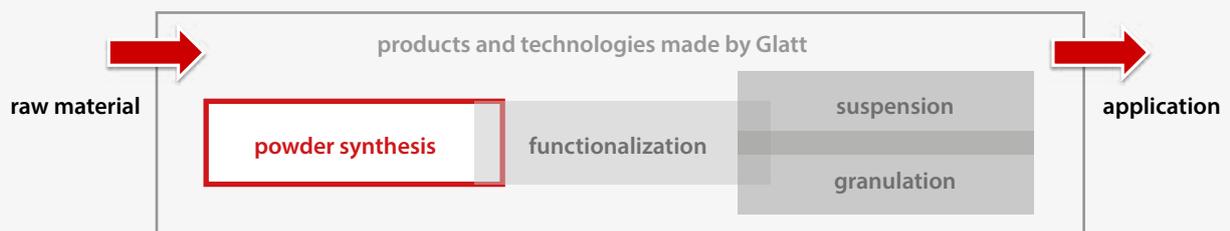
Customized granules

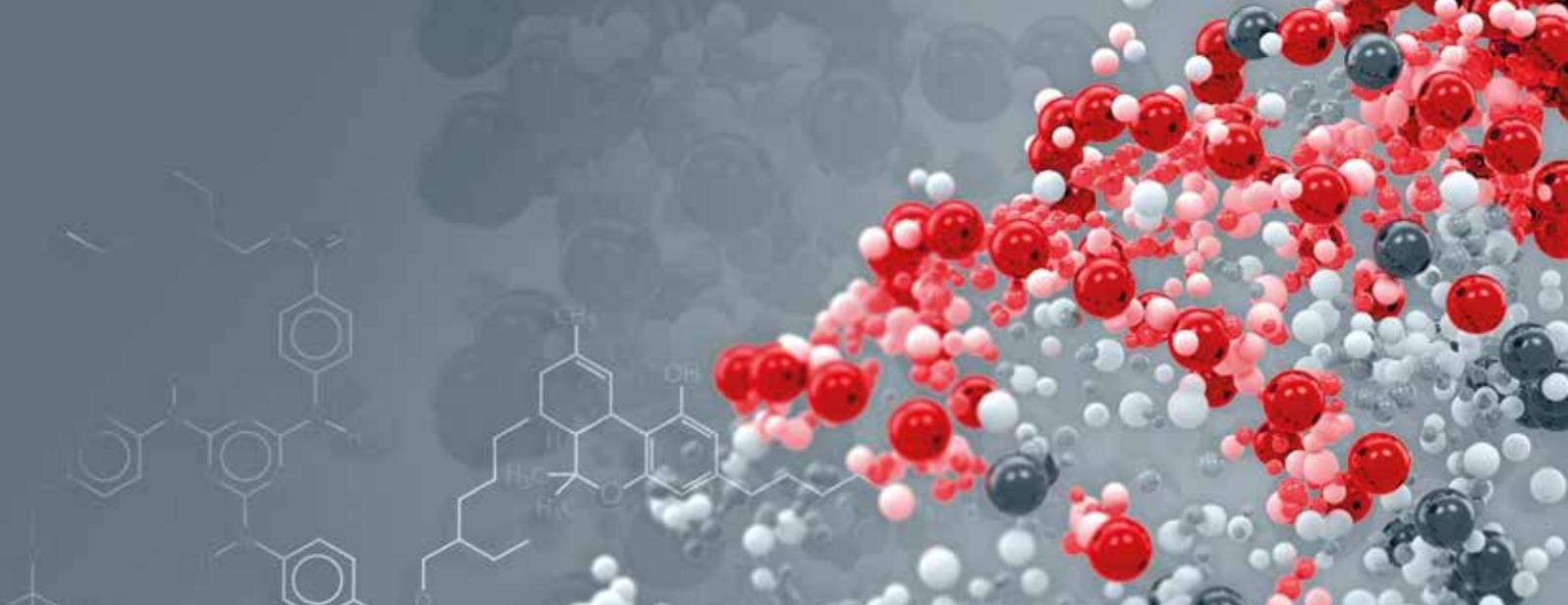
- » We are the pioneer in fluid bed granulation technologies with more than 60 years of experience
- » Different technologies in laboratory up to production scale



Whether spray granulation or agglomeration

Complete service from powder to granules made by Glatt





R&D service

From the idea to large-scale production

Our scientific and engineering competence forms the basis for successful material development and is fully available to you in all development steps.

Our laboratory offers numerous analytical and experimental options for basic and initial screening trials as well as the determination of influencing parameters. In addition, it guarantees quality assurance and certification.

Our powerful technology center allows trials and studies on a (small) technical scale. In this way, the process is optimally set up. Sufficiently large samples can be produced for application trials, even on a scale of tons.

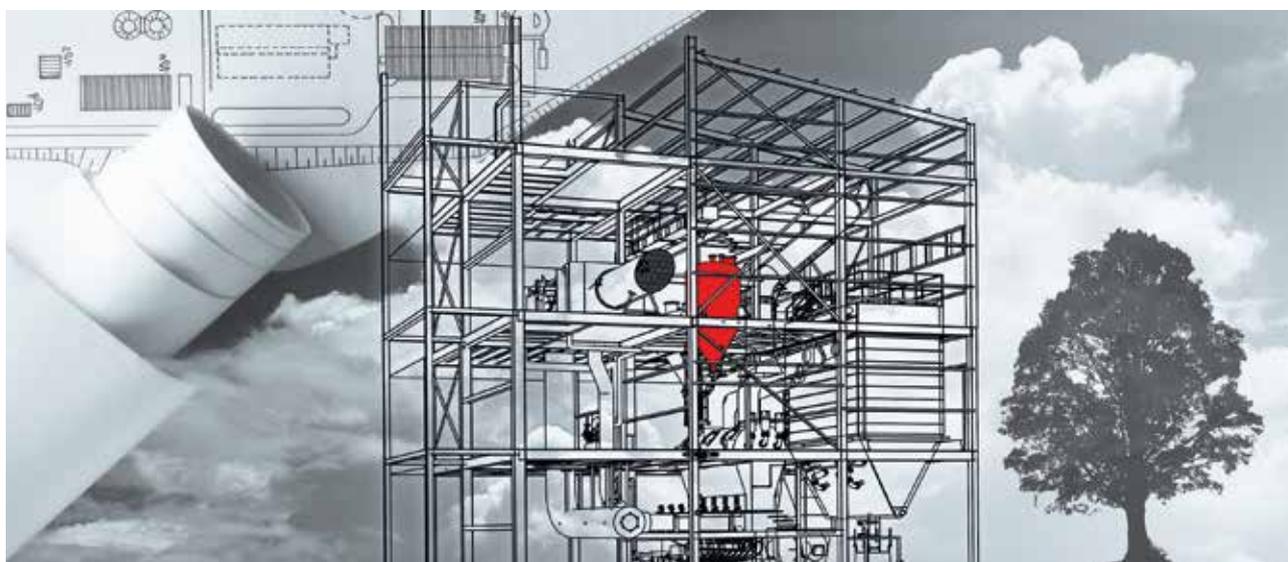
YOUR choice

Contract manufacturing or own production facility

Our contract production facilities offer sufficient capacity for the production of your specific materials. This allows you to deliver directly to your customers while securing key market shares due to speedy action.

The production of course follows strict quality rules and certification based on your requirements, controlled and certified in our laboratory.

Our plant engineering designs and realizes your own production facility. We not only provide you with the technology required for the manufacturing process but we also offer the process know-how as a complete package.





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