

Degussa Product Story

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At the European space center in Kourou, French-Guiana, a Soyuz launch pad will be established where the first rocket will be launched at the end of 2008

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High-concentration Space Travel

When the first Soyuz-2 carrier rocket launches into space from the Kourou Space Center in late 2008, the RAG subsidiary Degussa will have made a major contribution. The world's biggest specialty chemicals company is the second-largest manufacturer of hydrogen peroxide.

Kourou Space Center, French Guiana. A Soyuz rocket awaits take-off. The men and women at the mission control center in Kourou are all hard at work; the air is abuzz with their intense concentration. At 82.5 percent, the hydrogen peroxide (H_2O_2) on board the rocket is also "highly concentrated". It drives the turbo pumps, which force the actual fuels – kerosene and liquid oxygen – into the combustion chambers. As the rocket lifts off, ten tons of H_2O_2 will be used up in the space of a few minutes.

The described scenario is still a future vision, but it is fast becoming a reality. After the fall of the Iron Curtain and the dissolution of the Soviet Union, Russia's space agency Roscosmos began looking beyond Russian borders, which included seeking and establishing closer contact to the European Space Agency ESA. The Soyuz experts have launched nearly 1,800 space missions since the beginning, and now they are no longer limited to the bases at Baikonur in Kazakhstan and Plesetsk in Siberia. In the future, Russia will also launch from Kourou, whose location close to the equator (5° north) gives the rockets an extra boost, as the rotational speed of the earth is highest close to the equator.



Contact with Russia

Once ESA and Roscosmos had agreed to collaborate on Soyuz launches in French Guiana, the Russian company TsENKI, a service provider for space launches and supplier of rocket fuel components, started scouring the global market for capable partners. “We first made contact back in June 2005,” recounts Dr. Norbert Nimmerfroh, Head of Application Technology, Active Oxygens at Degussa’s Building Blocks division. “We sent TsENKI samples of our hydrogen peroxide PROPULSE™, which resulted in a visit by a Russian delegation to our facilities in Hanau-Wolfgang, where our research and application technology is headquartered, and Rheinfelden, where this grade of H₂O₂ is produced, in April 2006. In August 2006, the next step was taken when we inspected the rocket test site, in particular the H₂O₂ filling station in Samara, a town in the south of the European part of Russia.” Klaus-Dieter Lux, the Sales Director responsible for Central and Eastern Europe, adds: “Just a month later, in September, ten tons of PROPULSE™ 825 were delivered to Samara via St. Petersburg in a special container, and the product was qualified and approved.” Extensive testing of the H₂O₂ ensued, along with tests using catalysts. The intensive collaboration paid off and the rocket test in November using the hydrogen peroxide supplied by Degussa was a success.

Safe Transport

Production isn’t the only step at which expert know-how is essential. Highly concentrated peroxide has a tendency to decompose when warmed or in the presence of heavy metals, which needs to be suppressed during transportation and storage – first for safety, and secondly in order to ensure a consistent and reliable supply of the desired quality to the customer. Apart from this, rockets require especially pure hydrogen peroxide, because any impurities would deactivate the catalyst. Therefore the requirements for the stabilizing the hydrogen peroxide with additives are even stricter than usual. The more concentrated and hence purer the H₂O₂ is, the more exacting the requirements for transportation.

Degussa has developed specifically approved containers for the process. The inner walls of the containers are first pickled using a complex procedure, after which a protective passive layer is applied and treated with hydrogen peroxide. The properties of concentrated H₂O₂ call for an individual calculation of the pressure relief that is required by law for transporting such materials; and temperature and GPS monitoring is also needed. “We managed to convince our Russian partners that we are capable of supplying the required 82.5 percent purity reliably, and even to deliver it to Kourou in South America, over 8,000 kilometers from Europe,” says Norbert Nimmerfroh

Long Years of Experience

Hydrogen peroxide is a clear liquid that is easily confused with water at first sight. In the usual production process, H_2O_2 is formed as an aqueous solution. Normal commercial concentrations are usually between 30 and 70 percent. "Degussa has decades of experience in manufacturing hydrogen peroxide using a process it developed itself and it has the technical expertise to be able to concentrate this aqueous solution up to 98 percent," says Nimmerfroh. Such high concentrations of hydrogen peroxide are also needed to power space rockets. The technology used in launching the rockets makes use of the fact that hydrogen peroxide decomposes when heated or in the presence of heavy metals, forming water and oxygen and releasing thermal energy.

So what happens when a rocket is launched?

A standard liquid-fuel rocket engine contains the liquid fuel and the oxidant in separate containers. Both of these need to be fed to the rocket engine under high pressure to produce the necessary thrust. "The liquid H_2O_2 decomposes over a heavy-metal catalyst, generating a lot of heat. This produces gaseous oxygen and steam, which together drive the turbo drives, which in their turn supply kerosene and liquid oxygen as the oxidant to the rocket engines at about 20,000 – 30,000 rpm." Everything happens at breakneck speed during this sort of launch, with ten tons of hydrogen peroxide being used up in just 300 seconds.

The specialty chemicals manufacturer has at least ten years of experience with hydrogen peroxide in connection with space travel. At the time, it first established contact with an American company that was working on developing a three-stage carrier rocket. "We monitored its development and gained a great deal of experience in the process," Nimmerfroh recalls. "Today we benefit from the fact that we dealt with the topic so thoroughly, in our logistics and material compatibility testing for instance. And as a subcontractor for the American Orbital Sciences Corporation – a company that concentrates on building and launching earth satellites – we've even produced 98 percent H_2O_2 ."

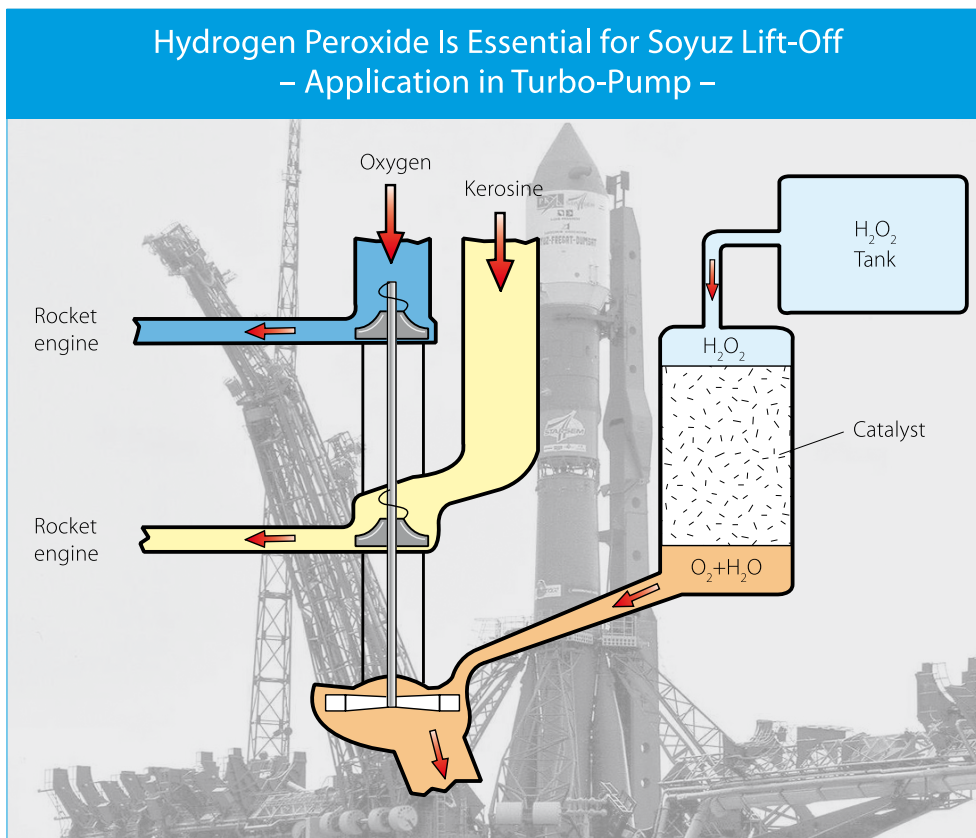
As Innovative as Ever

Hydrogen peroxide is one of the oldest products made by Degussa, and – though this may sound paradoxical – also one of its most innovative. Because, alEven though the substance has been known since its discovery in 1818 by Louis-Jacques Thénard, the French chemist who first synthesized it, new applications are still being developed. Ones that, as Nimmerfroh says, "We develop in dialog with our customers, or based on our own ideas." Hydrogen peroxide production at Degussa began almost 100 years ago in Weißenstein in Kärnten, Austria, using an electrochemical process. Degussa eventually developed its own process, the so called anthrachinone process, and in 1962 built its first own H_2O_2 plant that uses this process in Rheinfelden in southern Germany.

Degussa is also currently working on another new hydrogen-peroxide production process in cooperation with a U.S. partner, Headwaters. In this innovative process, hydrogen peroxide is produced directly from hydrogen and oxygen. This method was developed to supply hydrogen peroxide as an oxidant for chemical synthesis, in anticipation of a large future market.

Global Production

Degussa has an annual production capacity of approx., 600,000 tons of H_2O_2 . It has production facilities in Germany, Belgium, Italy, Austria, the U.S., Canada, Brazil, Korea, Indonesia, New Zealand and South Africa. H_2O_2 is used for a very wide range of applications. The largest quantities are used in pulp bleaching, waste paper recycling and in manufacturing washing powders and liquids; the chemicals industry uses hydrogen peroxide as an oxidant. Other areas of use include pollution control, packaging disinfection and the treatment of waste water and drinking water. Sudden blondeness also indicates that hydrogen peroxide may have been at work. And, of course – which brings us back to the topic at hand – it is used in rocket engines.



Degussa

The Degussa Building Blocks division supplies highly concentrated hydrogen peroxide, which is used as a fuel component for launching Soyuz rockets, to TsENKI.

TsENKI

The Russian company TsENKI is a service provider for space launches and is the main point of contact for the supply of rocket fuel components in Russia and for Degussa.

Roscosmos

Roscosmos, established in 1992, is the Federal Space Agency of the Russian Federation.

TsSKB Progress

TsSKB Progress builds Soyuz (which translates to "alliance") carrier rockets in Samara in the south of the European part of Russia.

Arianespace

Founded in 1980, this company is responsible for the operation and marketing of the European Ariane 5 carrier rockets.

Kourou

The Space Center used by the ESA was built in Kourou, a town on the Atlantic coast of French Guiana, in 1965.

ESA

The European Space Agency (ESA) was established in 1975 and currently has 17 member states. It coordinates European space projects.

The European Space Program

The European Space Agency (ESA) is responsible for managing the "Soyuz at the Guiana Space Centre" program, with a budget of €344 million, and is thus the contractor for the European and Russian space industry. The ESA will make the Soyuz launch complex available for commercial use following completion of the Arianespace operations.

The program operated by the ESA aims at establishing increased cooperation with Russia on carrier rockets. Soyuz complements the European carrier rockets Vega and Ariane 5, and opens up the possibility of launching manned space flights from the European space center in French Guiana at some point in the future. The first Soyuz launch from Guiana is planned for late 2008.

The program has three key elements: to establish a Soyuz launch pad at the Guiana Space Centre, make technical adaptations to the Soyuz carrier rocket for operation in French Guiana (climate, security, technical Interfaces), and contribute to boosting the performance of the third stage.

Degussa—a wholly owned subsidiary of the RAG Group—is the global market leader in specialty chemicals. Our business is creating essentials—innovative products and system solutions that make indispensable contributions to our customers' success. In fiscal 2006 around 36,000 employees worldwide generated sales of 10.9 billion euros and operating profits (EBIT) of more than 870 million euros.