From the onset safety concerns are taken into account in the engineering of new Bayer plants. Assisting in this process are experts from Bayer Technology Services, such as Augusto Perico-Cortes – a proven specialist, especially in manufacturing and processing facilities for phosgene.

Perico-Cortes is one of some 60 colleagues working in Process & Plant Safety (PPS) at Bayer Technology Services in Leverkusen. About a third of this staff investigates important substance properties in the laboratory. The rest, including the Colombian, are sent to locations all over the world where Bayer or some other client is planning a new facility or the reconstruction of an existing one. As PPS employees, they know all about how to effectively prevent hazardous situations that may occur in chemical facilities. The secret is preparing suitable safety concepts, and since these plants are built throughout the world, PPS staff members are frequently found in jetting off to far away places and spending the night in hotels.

Sometimes, however, Perico-Cortes is simply on assignment in northern Germany, or not even 30 kilometers away from Leverkusen in Dormagen. For example, Bayer MaterialScience is currently building a new facility in Dormagen for the production of the polyurethane raw material TDI. Perico-Cortes spent a lot of time there when the construction of this plant was being prepared. The work began in January 2009 with a safety review of the plant concept.

TDI is an isocyanate, and a plant for the production of phosgene is always part and parcel of every facility involved in the manufacture of isocyanates. At the preliminary production stages the amine groups are converted into isocyanate groups with the help of this chemical. This is the conventional process in isocyanate synthesis.

Under normal conditions, phosgene is a gas. Even in small quantities it is toxic for humans, and therefore the handling of phosgene requires very special safety measures. Here it is important to remember phosgene is needed solely as an intermediate that is directly and completely further processed. As mentioned above, it reacts with amines to form isocyanates. The required quantities can thus be calculated so that only the amount needed for further processing is synthesized at one particular time. For this reason the chemical does not have to be stored. In addition, at all sites where Bayer MaterialScience requires phosgene, the rule is that the phosgene synthesis must take place in immediate proximity to the further processing unit. As a consequence, any pipelines carrying phosgene can be kept short.

Nevertheless, a number of safety precautions are still necessary. Among these are measures to prevent phosgene from escaping into the atmosphere. This may include, for example, pipes with a double wall.

Augusto Perico-Cortes is among the employees in the Bayer Group with the most experience in dealing with phosgene.
Augusto Perico-Cortes cannot always care for his ficus trees himself (above). The expert for engineering plant safety (below left) is often away on business trips (below right).
plant safety. His first involvement with a phosgene plant was in 1984, when the engineer had been with Bayer for just two years. At the time he was employed as a process control engineer at the company’s Belford Roxo in Brazil, where a manufacturing facility for MDI was just being built. MDI is another isocyanate that is required for the production of polyurethanes, and like TDI, it is produced with the help of phosgene.

That was nearly 30 years ago, and in the meantime, Perico-Cortes has helped engineer the safety features of many new plants. Working as a PPS expert since 1990, he has been involved in 22 phosgene plants around the world over the years. It is therefore no surprise that for some colleagues at Bayer, he is known as “Mr. Phosgene”. And this nickname is not so far from the truth, considering that he has been a long-standing member of the Bayer Global Phosgene Steering Group (PSG). As Chair of the PSG PPS Group he has provided valuable services for Bayer’s phosgene safety for many years now.

Perico-Cortes does not protest when people refer to him as Mr. Phosgene, but he feels the association is actually far too simplistic. “We always work in a closely coordinated team,” he

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**“The safety experts at Bayer Technology Services contribute to the fact that the handling of the intermediate phosgene at Bayer is safe, environmentally correct and highly efficient.”**

Dr. Kurt Meurer, Head of the Global Phosgene Steering Group, Bayer MaterialScience

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**Various applications for phosgene**

Phosgene plays an important role in many chemical syntheses – for instance, when it comes to converting amines into isocyanates. In turn, isocyanates are an important starting material for the production of polyurethanes, one of the most versatile classes of polymers. Phosgene is also a primary component in the synthesis of polycarbonates, which are used, for example, to produce CDs and DVDs, as well as many components for application in the automotive, energy and leisure sectors. Phosgene is also important as an intermediate for the production of crop protection agents and active pharmaceutical ingredients as well as of special chemicals used in high-tech applications.
stresses. “The contribution of each individual is important and therefore we form a Phosgene Team.”

As such, Perico-Cortes collaborated right from the beginning in a large team to plan the safety requirements for the TDI plant in Dormagen. Engineers, chemists, production foremen, automation experts and specialists in environmental protection, occupational safety and many more were all involved. A lot of them were employees of the client and later plant operator, in this case Bayer MaterialScience. “Bayer Technology Services offers bundled expertise encompassing planning, construction and commissioning of facilities,” explains Perico-Cortes. The plant safety experts from PPS contribute, in particular, know-how collected over many years in the special fields of explosion and fire prevention as well as occupational safety.

The team first runs through all possible scenarios in advance. What would happen if the temperature here or the pressure there were to suddenly increase? What if a chemical got into the wrong pipe? Or if valve x or pump y malfunctioned? Or what if a sealing gasket on a reactor leaked? “In the early days of industrialization, people just reacted to accident events,” says Perico-Cortes. “Today, we try to anticipate any possible events beforehand – and either through suitable precautions prevent them from happening in the first place or ensure that any incidents remain without consequences.”

But why is it necessary every time you build a new plant to make such an effort years before construction even begins? After all, Bayer MaterialScience operates many other large-scale TDI plants around the globe. Hasn’t it already become common knowledge and perhaps even standardized, where certain safety measures are required? “We always consider everything very carefully – even if it is for the umpteenth time,” stresses Perico-Cortes. For one thing, technical knowledge is constantly increasing, and for the other, each plant is unique when it comes to its integration in the existing infrastructure of a site. Among the special features are, for instance, energy supply and the feed of intermediates. Taken in this context, the large-scale facility in Dormagen is also unique.

By the time construction begins, Perico-Cortes has long moved on to the next projects. Among other things, he is currently working on two existing MDI facilities – one in Uerdingen and the other in Brunsbüttel. In Brunsbüttel it is a case of restoration and expanding, and in Uerdingen it is another periodic safety review. As Bayer has prescribed in its own safety management procedures, all facilities are reviewed in relation to their plant and process safety every five years. “For example, we always check to see whether there are new insights that will help us tighten the safety net even more,” explains Perico-Cortes.

As in Dormagen, parts conveying phosgene will also be included in the MDI facilities in Uerdingen and Brunsbüttel. Not surprisingly, the colleague from PPS who will participate in team meetings is Augusto Perico-Cortes. Since most of this year’s work will be in Germany, his ficus trees stand to benefit as well. For once the specialist in phosgene plant and process safety will be able to water them himself more often.