Cement builds cities

Frankfurt am Main. Inside the futuristic glass and concrete build-ing, an elevator races to the twenty-first floor. As the door slides open, Maike (38) looks out over a spectacular ensemble of high-rise towers. An amazing panorama which she now hopes to be seeing more often. But first she has to get through the interview.

Munich – Berlin. “Train arriving 18:26.” Thumbs flying over his smartphone, David (19) types in the message and waits impatient-ly for the two checks to turn blue. Beyond the window to his side, green landscapes flash by. “Meet you on the platform” replies Sa-har (18), adding a heart-eyes emoji. David grins as the ICE enters a tunnel.

Hamburg. On thick steel cables, the mighty concrete structure of the Köhlbrand bridge spans the river Elbe. Like a colorful army of ants, runners ascend the slope meter by meter. Panting, Christina (30) reaches the top, and the breathtaking view of the Hamburg skyline spurs her on to complete the final kilometers of her run.

Buildings and towers that dominate the skylines of our cities, roads, bridges and tunnels that bring lovers together … without cement our cities and infrastructures would be unthinkable. It's what binds everything together. With global production of over 4 billion tons, cement is our most important material. It is produced in cement plants built by and using equipment from thyssenkrupp Industrial Solutions.

Far back in ancient times, the Romans developed opus caementitium, a building material made from burnt lime. For our modern-day cement, natural raw materials such as limestone, clay, sand and iron ore are ground to raw meal, heated and then burnt in a kiln at around 1,450 degrees. At these high temperatures the individual components of the mix begin to combine. The resultant cement clinker is cooled to below 100 degrees Celsius and ground with gypsum to produce Portland cement. A major advantage of cement is that it hardens both in air and under water. When mixed with water, sand and an aggregate, it forms a material with extremely high compressive strength: concrete. Reinforced with steel it also offers exceptional tensile strength and is an indispensable part of our daily life. It is used in transportation structures such as bridges, tunnels and retaining walls as well as in the foundations and support structures of buildings from single-family homes to skyscrapers.

thyssenkrupp Industrial Solutions offers end-to-end solutions for the construction of cement plants: These include equipment for raw material extraction, various types of crushers, circular blending beds for the storage and homogenization of the raw material mix, conveyors, roller mills for grinding the raw meal, rotary kilns for burning the cement clinker, and equipment for grinding, storing and transporting the cement.

Reducing emissions

But cement has a downside: seven percent of man-made CO_2 emissions worldwide are caused by cement production. A large part of these emissions come from generating the heat and electricity needed for the production process. To reduce energy consumption, thyssenkrupp Industrial Solutions has developed polab, a laboratory automation system. The digital monitoring, control and optimization of the individual process steps increases the efficiency of the production plant – thereby cutting heat and electricity consumption and reducing environmental impact. Also, in addition to fossil fuels such as coal, gas and oil, thyssenkrupp Industrial Solutions uses alternative materials for the combustion process. Alongside wood, paper, biomass and residual materials, these include household as well as industrial waste. This can reduce direct CO_2 emissions in cement production by up to 40 percent. In addition to carbon dioxide, other harmful substances are emitted in cement production, such as

nitrogen oxides (NO_X). thyssenkrupp Industrial Solutions' CemCat SCR technology minimizes these emissions. SCR stands for selective catalytic reduction: with the help of ammonia, the nitrogen oxides in the flue gas are broken down into nitrogen – which makes up 78% of the air we breathe – and water.

Most of the carbon dioxide occurs when the limestone is converted into clinker. In this process, known as calcination, CO_2 is released from the limestone and emitted as flue gas. Due to the use of limestone and the CO2 bound in it, these process emissions are unavoidable. However, with the Oxyfuel process, thyssenkrupp Industrial Solutions has developed a method for capturing these carbon dioxide emissions and processing them into valuable raw materials. Normally ambient air is used for the combustion and preheating process in the kiln. Due to the nitrogen present in the ambient air, the CO2 content in the flue gas is not high enough to be utilized efficiently. The Oxyfuel process uses pure oxygen for burning and preheating the cement clinker. The flue gas is highly concentrated CO_2, which is captured and reused. Together with research institutes and other companies, thyssenkrupp Industrial Solutions is working on methods of reusing carbon dioxide in the Carbon2Chem® project. The captured CO_2 can already be used for the production of fertilizers, plastics, and even fuels. Clay offers another possibility for reducing greenhouse gas emissions. By substituting thermally activated clay for part of the clinker, process-related CO_2 emissions can be significantly reduced. And up to 40 percent less energy is required to burn the clinker, because activation of the clay is achieved at lower temperatures of around 900 degrees Celsius. That's good for operating costs and above all good for the environment.

The bottom line: Maike's panoramic view of the Frankfurt skyline, Christina's sprint over the Elbe, and David and Sahar's long-distance relationship … For our buildings and roads we need cement. And it is

the expertise from thyssenkrupp Industrial Solutions that ensures that we can use this unique material to build our cities and infrastructure – while minimizing its impact on the environment.
