
Sustainability and the cement industry – Abstract

Sustainability as a global vision

In the Agenda 21, the world community agreed on a vision for sustainable development. Business gains a leading role in this. The Federal German Association of the Cement Industry (BDZ), the German Cement Works Association (VDZ), the Socio-political Working Group of the German Cement Industry (SPADZ) and the Trade Unions for Building-Agriculture-Environment (IG BAU) and for Mining, Chemical and Energy (IG BCE) started first talks in 2000 about cooperation in the field of sustainable development.

Both sides of industry believe that ecological, economic and social requirements should be better coordinated as in the past. These three targets need to be integrated at every stage in the value chain (extraction of raw materials, cement production, concrete production, construction and use, concrete recycling) by determining synergies. Employers' associations and trade unions comprehend sustainable development as a learning process, starting from the opportunities for action available to the companies and their employees. Both sides of industry believe that the key factors to success are investment and innovation. The various options offered by industrial products and processes should be developed.

Key features of the cement industry

36.1 million tons of cement were produced in Germany in 2000 in 59 works with around 11,000 employees. Despite weak demand in construction activity and increasing globalisation, the gross investments in plant between 1995 and 2000 totalled € 1.7 billion. The cement industry is characterised by three features. Firstly, it is very capital-intensive – returns on investments are only made in the long-term and require a constantly reliable supply of raw materials. Secondly, the cement industry is fixed by location – it relies on raw material deposits in the immediate vicinity of the plants and predominantly sells its products in regional markets. Thirdly, the cement industry is an intensive user of raw materials and energy – raising resource productivity is vital for operational reasons alone. Current trends

include on-going globalisation, so that competitive framework conditions are becoming ever more important, even though cement production is more or less tied to fixed locations. Cement is primarily a homogenous, mass-produced good for the construction industry; nevertheless, the variety of types is increasing and special respective innovative cements are gaining in significance.

The cement industry has become a high-tech sector which deploys systems for automated material transport, computerised process control and extensive quality assurance. A skilled workforce is required accordingly. This is reflected in the high training rate of 8%, which is clearly above the German average. The cement industry is at the hub of an industrial cluster concerned with producing mineral building materials. This network includes power generators, equipment suppliers and production-related service providers, with whom close collaboration exists to raise energy efficiency and to protect the environment. Added to this, there are producers of concrete on the customer side. This cluster provides a total of 100,000 jobs in Germany.

Alongside the companies in the cement industry, other actors are bound into the overall process at each stage of the value chain. Apart from the supplier and customer sectors, neighbourhoods of the plants, local authorities, political institutions at EU, federal and regional levels belong to this as well as relevant interest groups (particularly environmental groups, economic associations and trade unions). Both sides of industry believe that cooperation with the stakeholders is an important prerequisite for sustainable development.

Contributions to sustainability in the value chain

The value chain of cement-based building materials starts with the **extraction of raw materials**: Around 1.6 tons of limestone and clay are required to produce 1 ton of cement clinker, the burnt intermediate product. This is of great significance to sustainable development because, on the one hand, mineral raw materials form the material basis of the

cement and construction industries. On the other hand, their extraction involves environmental impact. Nevertheless, the area required to extract raw materials is relatively small, being some 0.0002% of Germany's total land surface.

Although raw material extraction has become more friendly to the environment, conflicts with other needs for land use have increased. In this context, it is often not recognised that raw material extraction uses land *temporarily*, and can be integrated into appropriate regional development strategies. Thus by 2000, nature conservation had been implemented in around 54% of former quarries; their previous use, in contrast, was dominated by intensive agriculture. Quarries can also contribute to nature protection even during their operation – management recommendations have recently been developed.

Forecasts show that future demand for cement-based building materials in Germany will be more or less stable. They often cannot be substituted for technical reasons. In order to preserve natural resources, the use of alternative raw materials and coupled products from other industries has risen in recent years, so that their share of raw material input for producing cement clinker is now around one fifth. The cement industry's contribution to recycling economy and industrial ecology is to be further expanded in future; this, nevertheless, requires the availability of suitable secondary materials.

Cement production involves the preparation of raw materials, burning of cement clinker and cement milling. A major focus of sustainable development lies in reducing emissions, an area in which remarkable progress has already been made. This applies particularly to emissions of dust, trace elements, nitrogen oxides and sulphur dioxide. Process innovations have reduced energy consumption, enabling specific fuel consumption to be cut by 60% since the 1950s. The German cement industry has set itself the target of reducing specific CO₂ emissions from energy consumption by 28% between 1990 and 2008/2012. This target is an important contribution to the climate protection agreement made between the Federal

Government and industry. Energy-related emissions of the German cement industry have already been cut by almost 24% since 1990. It can be assumed that the self-imposed target will be successfully met.

Apart from the remaining potential for process improvements, the cement industry will reduce CO₂ emissions by partly using other materials to substitute the burnt clinker (e.g. blast furnace slag). Another option is to use alternative fuels to save on fossil energies, meaning that waste does not need to be burnt or land-filled at other places. Further potential to reduce CO₂ emissions can be exploited abroad. An international strategy to cut CO₂ emissions is therefore important for the cement industry. The 'flexible mechanisms' of the Kyoto Protocol need to be further-developed, but should not distort competition with negative effects on production and jobs in Germany.

Great progress has been achieved in reducing noise pollution and increasing industrial safety. The rate of accidents in German cement plants has fallen by over 70% over the last 30 years. This means that the accident rate is around one third less than for the industry as a whole.

In **Concrete production** cement is mixed with gravel, sand and water. Most important products are ready-mixed concrete, precast concrete elements, setts and lightweight concrete stones. As far as sustainable development is concerned, the compressive strength of the concrete is important in enabling construction parts to be produced with smaller cross-sections, thus increasing eco-efficiency. Compressive strength depends mainly on the quality of the cement and is a central field of innovation in the industry. The maximum compressive strength has been five-fold increased since the 1960s and is now around 200 N/mm².

A further field of action is concrete recycling. The production residues from concrete manufacturing are completely returned to the cycle and reused. The concrete rubble left after old buildings have been demolished can also be fully recycled. Cement is needed for this and also allows other construction materials to be reused, such as crushed bricks, which are suitable as concrete aggregates. The rate of reuse for construction rubble in Germany was as high as 72%

in 1998. An increase in concrete rubble is likely in future, meaning that concrete recycling will gain in importance. Concrete rubble from road construction is today almost completely recycled. The proportion of concrete with recycled aggregates in building construction will probably increase in the future, now that technical standards for this have been worked out. The cement industry supports the recycling of construction materials and is involved in the German Initiative for the Recycling of Construction Materials.

Industrial health and safety is important in concrete production with regard to the chromate content of the cement. Chromate is created from the chromium in the raw materials during cement burning, and manual processing of cement can trigger allergic chromato-dermatitis. Representatives of the producers, users, employees and authorities made an agreement with a number of measures to combat it.

A major goal of sustainability in the **use of cement-based building materials** is to minimise the life cycle costs of buildings to meet the needs of housing. The costs of construction can be cut by deploying modular-building systems. Cement and concrete are fully in line with these requirements. An increased use of precast modules would, however, have effects in the construction industry: The volume of human work would be reduced, while at the same time higher qualification of the employees could be expected.

Sustainable development is concerned with saving resources in construction. The durability of buildings enabled by the use of cement and concrete is of great significance in this context. Appropriate measures have been developed to protect concrete structures from corrosion and mechanical wear. Additionally, the industry offers training in the correct application of cement and concrete. Further benefits of concrete as a building material are protection against noise and fire and in its good characteristics to protect against radon emissions from the ground.

Environmental impact has less to do with the construction of a building than with its use. Among other aspects, this concerns the required energy for heating. A combination of different measures enables the latest legal regulations on energy savings to be exceeded. Due to

their high heat storage capacity, concrete construction elements are eminently suited to solar power applications – this factor can be exploited with collector walls or by deploying solid absorbers and heat pumps.

Many goals of sustainable development can only be realised by the use of cement-based building materials. These include the water management: Concrete construction elements are required for percolating rainwater, for supplying drinking water and for purifying waste water. Cement and concrete are used in land-fill engineering and land recycling to seal and immobilise pollutants. In addition, concrete has an important role in the sustainable construction of transport infrastructures. Concrete roadways are characterised by their durability, load-bearing capacity and forming stability. They can be made permeable or non-permeable to water depending on special requirements. Concrete is also used in noise reduction applications. Firm tracks improve profitability, operational safety, maintenance and comfort, while at the same time help to protect the environment.

Initiative for Sustainability in the German cement industry

Significant steps towards sustainable development have already been made at various stages of the value chain of cement-based building materials. Many problems have been solved with notable success. Measures undertaken in other fields of action have crystallised the points in which further efforts can be directed. Both sides of industry have decided to implement an Initiative for Sustainability. Apart from further embedding the vision of sustainable development in the companies and organisations of the German cement industry, the initiative aims to deepen the dialogue with major stakeholders outside the industry.

Moreover, pilot projects are to be implemented which can give impulses to further progress towards sustainable development by interlinking social, ecological and economic aspects. Important topics are the extraction of raw materials and nature conservation, reduction of CO₂ emissions and climate protection, transport and logistics as well as information and training tools.