An Overview on Green Cement Technology
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Abstract

Concrete is generally considered to be the most widely-used manufactured material on Earth, with global demand now being of the order of 10 cubic km per year. This requires the manufacture of over 4 billion tonnes of cement per year, accounting for over 8% of global anthropogenic CO$_2$ emissions. Thus, even small improvements in cement technology can have a significant effect on global CO$_2$ emissions as well as on other globally-important sustainability indices.

Almost all concrete is made using hydraulic cements in which the main manufactured ingredient is Portland cement “clinker” (PCC). PCC itself is made by heating together a finely-ground mixture of limestone, clay and other minerals to about 1450°C. In the process, the “fossil” CO$_2$ contained in the limestone is emitted. For this reason, more than half of the CO$_2$ emitted in cement manufacture is essentially independent of the kiln fuel used. Although this “fossil” CO$_2$ is slowly re-absorbed by concrete in use, its lifetime in the atmosphere is of the order of centuries and so this reabsorption doesn’t help us much in the medium term. Thus, alternative binder systems which release less CO$_2$ during their manufacture are actively being sought by the cement research community. The acceptance criteria for alternative cements are, however, very stringent, because Portland cement is cheap, robust, and also very familiar to most users due to over a century of use. Moreover, the high alkalinity of Portland cement provides excellent corrosion protection to mild steel, making reinforced concrete a very durable structural material. Alternative binders must also perform this function, too.

During this lecture, some of the fundamental characteristics of hydraulic binders will be exposed, and several potentially important alternative options to Portland cements will be examined from scientific, ecological and industrial viewpoints.