TECHNICAL REPORT

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Carbon dioxide capture — Overview of carbon dioxide capture technologies in the cement industry

Captage du dioxyde de carbone — Vue d'ensemble des technologies de captage du dioxyde de carbone dans l'industrie du ciment

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 265, *Carbon dioxide capture, transportation, and geological storage*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Concrete is the most-used manufactured substance on the planet in terms of volume. For example, it is used to build homes, schools, hospitals, workplaces, roads, railways and ports, and to create infrastructure to provide clean water, sanitation and energy. These are important for quality of life, public health, and social and economic well-being.

Raw materials for concrete are abundant and available in most parts of the world. Concrete is affordable, strong, durable and resilient to fire, floods and pests. It has the flexibility to produce complex and massive structures. There is currently no other material that is available in the quantities necessary to meet the demand for buildings and infrastructure.

Cement is used to manufacture concrete. It is described as the glue that binds the aggregates together. The demand for concrete, and therefore for cement, is expected to increase, by 12 % to 23 % by 2050 compared to 2014, as economies continue to grow, especially in Asia.

Increasing global population, urbanisation patterns and infrastructure development will increase global cement production. The use of concrete and cement is expected to become more efficient, and concrete pours at the application phase are expected to decrease. The cement sector faces the challenge of meeting an increasing demand for its product while cutting direct CO_2 emissions from its production [7]. The cement industry is a large emitter of CO_2 worldwide. The industry is committed to reduce their carbon footprint to meet the targets of the 'Paris Agreement' on climate change.

Process emissions arising from the production of cement clinker present a fundamental challenge to decarbonization of cement. In normal cement production processes, these process emissions are in the range of 500 kg CO_2/tonne clinker to 540 kg CO_2/tonne clinker[1], corresponding to 250 kg CO_2 to 500 kg CO_2 per tonne of cement depending on the type of cement. Replacement of limestone as raw materials with alternative raw materials with lower carbonate content can reduce these process emissions, but availability of these alternatives is limited, and the replacement potential is also limited (depending on required cement qualities).

Combustion emissions are another contributor to CO_2 emissions in addition to the process emissions. Replacement of carbon-based fuels by non carbon-based energy sources and thermal energy from biomass sources (being considered as CO_2 neutral) will contribute to lowering the carbon intensity of the energy supply for the cement industry in the future.

One way to reduce CO_2 emissions is capturing CO_2 that is released in the production of cement (both direct emissions during the production process and emissions related to local energy production). CO_2 capture is an emerging approach for CO_2 abatement in the cement industry. It means that CO_2 arising from the combustion of fuels and from the treatment of raw materials could be captured and permanently stored or re-used. The integration of CO_2 capture equipment typically increases the specific energy intensity of cement manufacture, as additional energy is needed to operate the CO_2 capture plant, followed by drying, purification and compression of the captured CO_2 for transportation, (geological) storage and/or utilization[7]. CO_2 transportation, (geological) storage and utilization are beyond the scope this document.

To date, no large-scale CO_2 capturing technologies have been installed in the cement industry. However, different technologies are under development to support the cement industry in achieving their objectives. Various cement companies participate in one or more research, development and/or demonstration projects in the field of CO_2 capture. These projects provide useful information about the application of the various technologies in the cement industry.

To facilitate the assessment and comparison of the different CO_2 capturing technologies, this document summarizes these technologies that are currently under development. This summary supplements and updates the information provided in ISO/TR 27912:2016, Clause 10 on capture from cement production processes. This document will inform the cement industry and their stakeholders on CO_2 capture technology options and other relevant aspects.

CO_2 capture will be an item of interest for all cement producers in the years to come[5]. Currently, about 2 000 cement plants with relevant CO_2 emissions are operating worldwide[14] with the majority of these plants being located in Asia. CO_2 capture implementation in the cement industry at global level would need a transport and storage infrastructure to facilitate the decarbonization of cement plants not located close to a geological storage facility or CO_2 use facility. Together with the investments in CO_2 capture facilities, this will be a major cost factor for the cement industry.

Carbon dioxide capture — Overview of carbon dioxide capture technologies in the cement industry

1 Scope

This document provides an overview of technologies that are under development to capture carbon dioxide (CO_2) that is generated during cement manufacture.

This document is intended to inform users about the different technologies, including the characteristics, the maturity and the boundaries of these technologies.

This document is applicable to organizations involved in the cement industry and other stakeholders (e.g. policy makers).

This document addresses technologies for CO_2 capture that have potential applications in the cement industry. This document does not address CO_2 transport, CO_2 storage or CO_2 utilization.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 27917, *Carbon dioxide capture, transportation and geological storage — Vocabulary — Cross cutting terms*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 27917 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 CO_2 and the cement industry

4.1 Cement manufacture

Cement manufacture is a three-stage process: raw materials preparation, clinker production and clinker grinding with other components to produce cement. Figure 1 illustrates the process of manufacturing cement. Different raw materials are mixed and milled into a homogeneous powder, from which clinker is produced in high-temperature kilns where direct emissions of CO_2 occur. Calcium oxide from the calcination of limestone is a precursor to the formation of calcium silicates that gives cement its strength[7].