International Standard

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Second edition
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Environmental management for concrete and concrete structures —

Part 2: System boundary and inventory data

Management environnemental du béton et des structures en béton —

Partie 2: Limite du système et données d'inventaire

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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This document was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 8, *Environmental management for concrete and concrete structures*.

This second edition cancels and replaces the first edition (ISO 13315-2:2014), which has been technically revised.

The main changes are as follows:

— relevant ISO standards were cited;

— materials and work that were omitted in each life cycle stage were added;

— the absorption of CO_2 by concrete was taken into account.

A list of all parts in the ISO 13315 series can be found on the ISO website.

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 a material that is indispensable for the construction of infrastructure including civil structures and buildings. Massive amounts of resources are used for construction of this infrastructure and large amounts of concrete waste are generated when these structures are demolished. Concrete can therefore be regarded as a material having a critical impact on the formation of a recycling-based society from the aspect of not only resource consumption but also future waste generation. Meanwhile, a significant amount of CO_2, a greenhouse gas, is discharged from activities related to architecture and civil engineering. Various documents indicate that the concrete sector is emitting 5 % to 10 % of the global CO_2 by producing and conveying cement and concrete and by construction of concrete structures. On the other hand, concrete can absorb CO_2. Concrete, therefore, plays an important role in solving recycling and global warming problems. Consideration is given to the emission of air pollutants, noise, vibration, and other impacts during transportation of constituent materials and concrete, and construction and demolition of concrete structures.

Application of optimum environmental impact-mitigating techniques and use of environmentally conscious products are important issues for concrete structures at each stage of their life cycle: the production of cement and aggregate, the production and transportation of concrete, and the construction, use, and demolition of concrete structures. To meet these requirements, the environmental impacts resulting from different concretes as well as the structural forms, using life cycle inventory analysis (LCI) and life cycle assessment (LCA) are compared. LCI and LCA are conducted under the same conditions. In other words, it is important to clearly define a range of time and space for assessment, and quantitatively grasp the types and amounts of resources, energy, constituents, and components input into the range, as well as the products and structures output as a result of activities within the range, and also the by-products, waste, and other releases discharged. As shown in Figure 1, the boundary between the system under assessment and the outer region is referred to as 'system boundary,' and the input/output data transferred between the assessment system and the outer region is referred to as 'inventory data.' When conducting LCI and LCA, a system boundary is defined, and inventory data are quantitatively developed. This document provides fundamental rules for defining system boundaries and acquiring inventory data. The ISO 13315 series including this document provides specifications for concrete and ensures consistency with the existing environmental ISO 14000 series, ISO 15392, ISO 21930, etc.

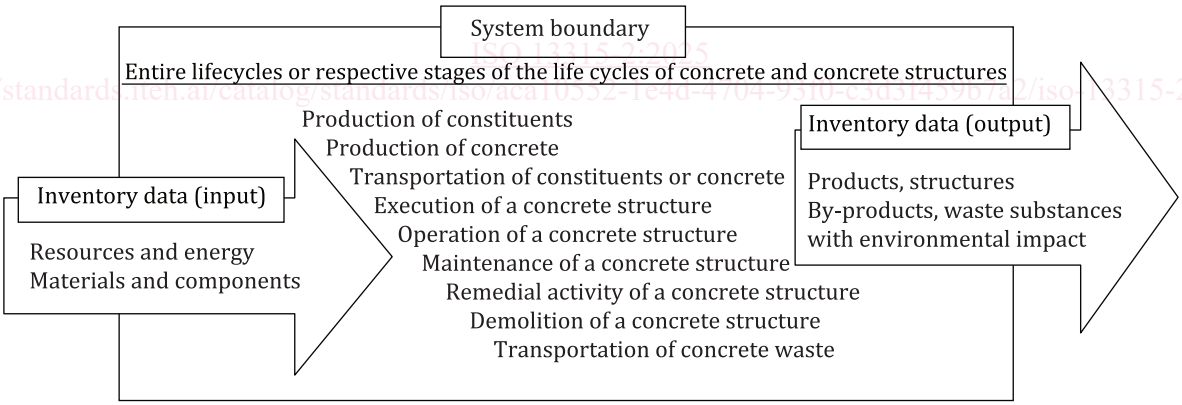


Figure 1 — System boundary and inventory data

Environmental management for concrete and concrete structures —

Part 2:
System boundary and inventory data

1 Scope

This document provides a general framework, principles and requirements related to the determination of system boundaries and the acquisition of inventory data necessary for conducting a life cycle assessment (LCA) of concrete, precast concrete and concrete structures.

This document is intended to be used in conjunction with, and following the principles set out in ISO 14040, ISO 14044, ISO 21930, ISO 21931-1 and ISO 21931-2. Where deviation occurs, this document takes precedence.

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 13315-1, *Environmental management for concrete and concrete structures — Part 1: General principles*

ISO 14025, *Environmental labels and declarations — Type III environmental declarations — Principles and procedures*

ISO 14050, *Environmental management — Vocabulary*

ISO 20915, *Life cycle inventory calculation methodology for steel products*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13315-1 and ISO 14050 and the following apply.

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

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

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

3.1
data collection boundary
boundary between the region, within which data is collected, and another region

3.2
input
resources, energy, materials or components which enter a product system

3.3
inventory data
set of items that should be considered in a life cycle assessment (LCA) and the corresponding quantitative measurements

3.4
life cycle inventory analysis
phase of a life cycle assessment (LCA) involving the compilation and quantification of inputs and outputs, for a given product system throughout its life cycle

3.5
output
products, by-products, emissions to air and water, wastes and other releases which leave a product system

3.6
system boundary
boundary between the system under assessment and the outer region, specifying which unit processes are part of a product system

3.7
unit-based inventory data
inventory data per unit quantity in time, mass, length, area, volume, etc.

4 System boundary

4.1 General

When conducting an LCA of concrete or a concrete structure, its system boundary shall be demarcated. Demarcation of a system boundary means defining the range of consideration for the assessment. For comparison among multiple alternatives, the system boundary shall be the same for all alternatives. When the acquisition of inventory data is difficult or cost-constrained, the target data can be excluded from the system boundary, but the exclusion should be expressly indicated.

For system boundary demarcation, the life cycle stages and geographical system ranges to consider should be appropriately defined.

The system boundary of concrete and concrete structures shall be based on a cradle-to-gate or cradle-to-grave basis and shall precisely describe what is included in the following activities: production of cement, water, additions, admixtures and aggregates, which are constituents of concrete; production of reinforcing steel; production of concrete; construction of concrete structures; use of concrete structures; demolition of concrete structures; reuse of concrete members; recycling and disposal of demolished concrete.

It is not necessary in principle to include in the system boundary the environmental impacts related to the production of equipment/machinery necessary for the production of concrete or the construction, use, demolition and recycling of concrete structures.

When explicit consideration of environmental impacts related to the production of equipment/machinery is deemed necessary, care shall be taken to eliminate double counting or omissions.

Activities indirectly related to the production of each material or to the construction of concrete structures, such as sales/administration, will possibly be included in the system boundary.

4.2 Constituents

4.2.1 Cement

The system boundary and data collection boundary related to the production of cement is generally expressed in Figure 2.

The system boundary for the production of cement shall include the following:

— the processes of quarrying, transporting and treating raw materials necessary for the production of clinker;

— transportation of the fuel necessary for the production of clinker;

— transportation of by-products;

— transportation related to waste-derived fuels;

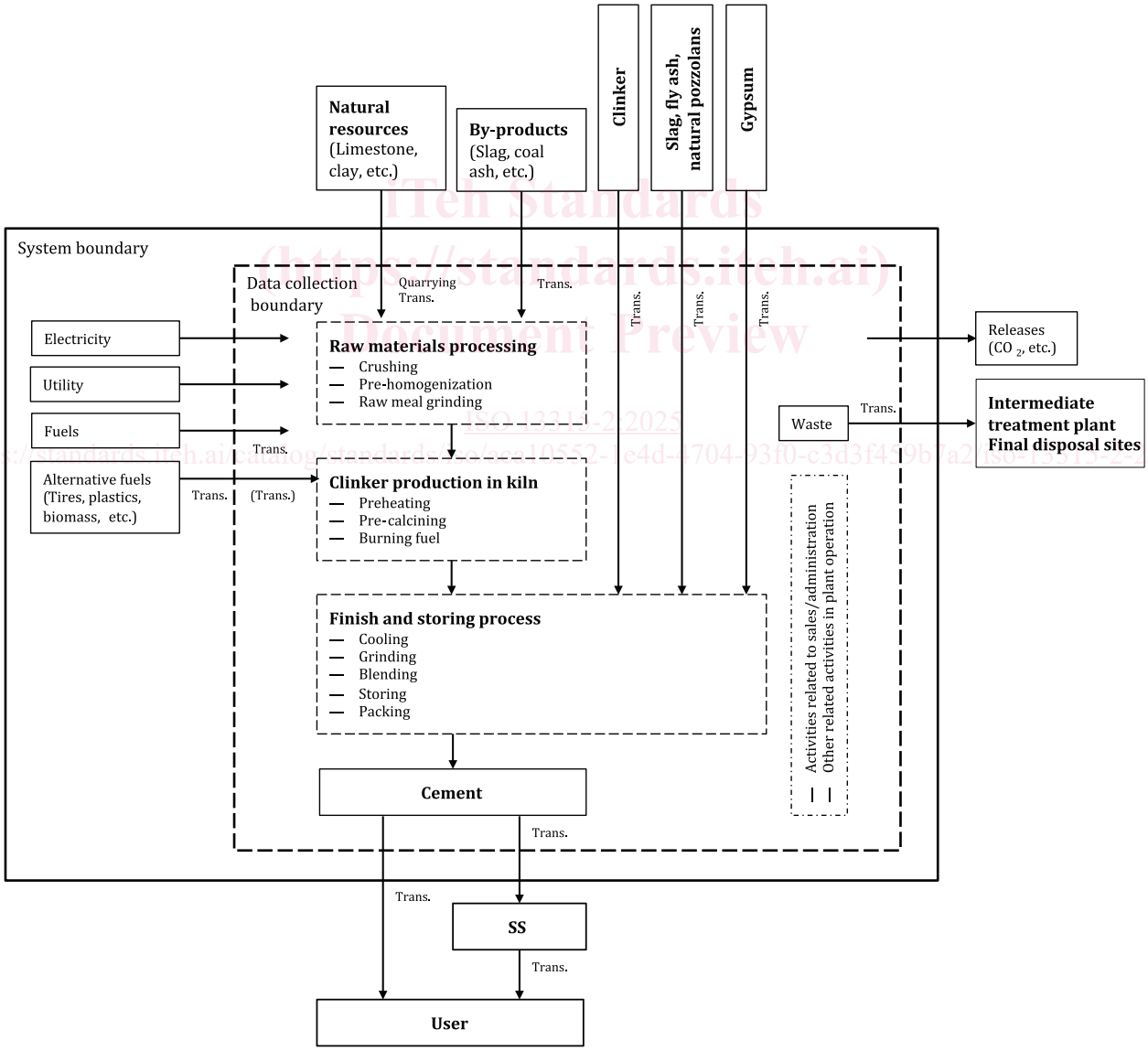
— all of the processes of material/fuel treatment, calcination and finishing of cement;

— the process of additional treatment to by-products used for the production of clinker;

— the process of additional treatment to waste-derived fuels for the production of clinker;

— transportation of cement from cement plants to supply stations (SS).

The system boundary for the production of cement shall not include transportation of cement from SS or cement plants to the place of use.



NOTE 1 Activities related to sales/administration and/or other related activities in plant operation will possibly be considered.

NOTE 2 The material/fuel treatment process includes crushing and adjustment of the materials/fuels.

NOTE 3 The finishing process includes clinker crushing and addition blending.

Figure 2 — System boundary of cement production

4.2.2 Additions and admixtures

The system boundary and data collection boundary related to the production of additions and admixtures is generally expressed in Figures 3 and 4, respectively.

The system boundary for the production of additions and admixtures shall include the following:

— transportation and storage of raw materials;

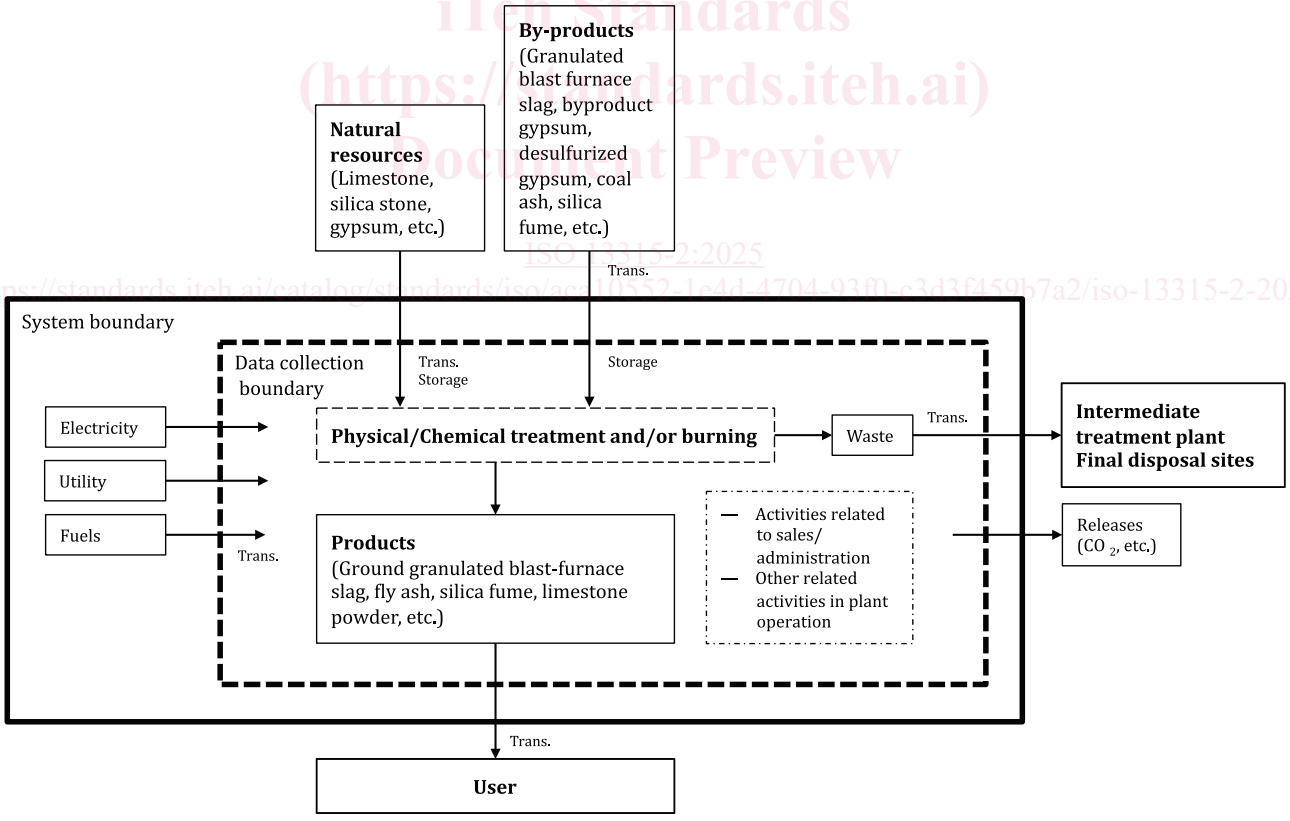
— transportation of fuels necessary for the production of additions and admixtures;

— physicochemical treatment of raw materials at addition and admixture production plants;

— transportation of waste to intermediate treatment sites and/or final disposal sites.

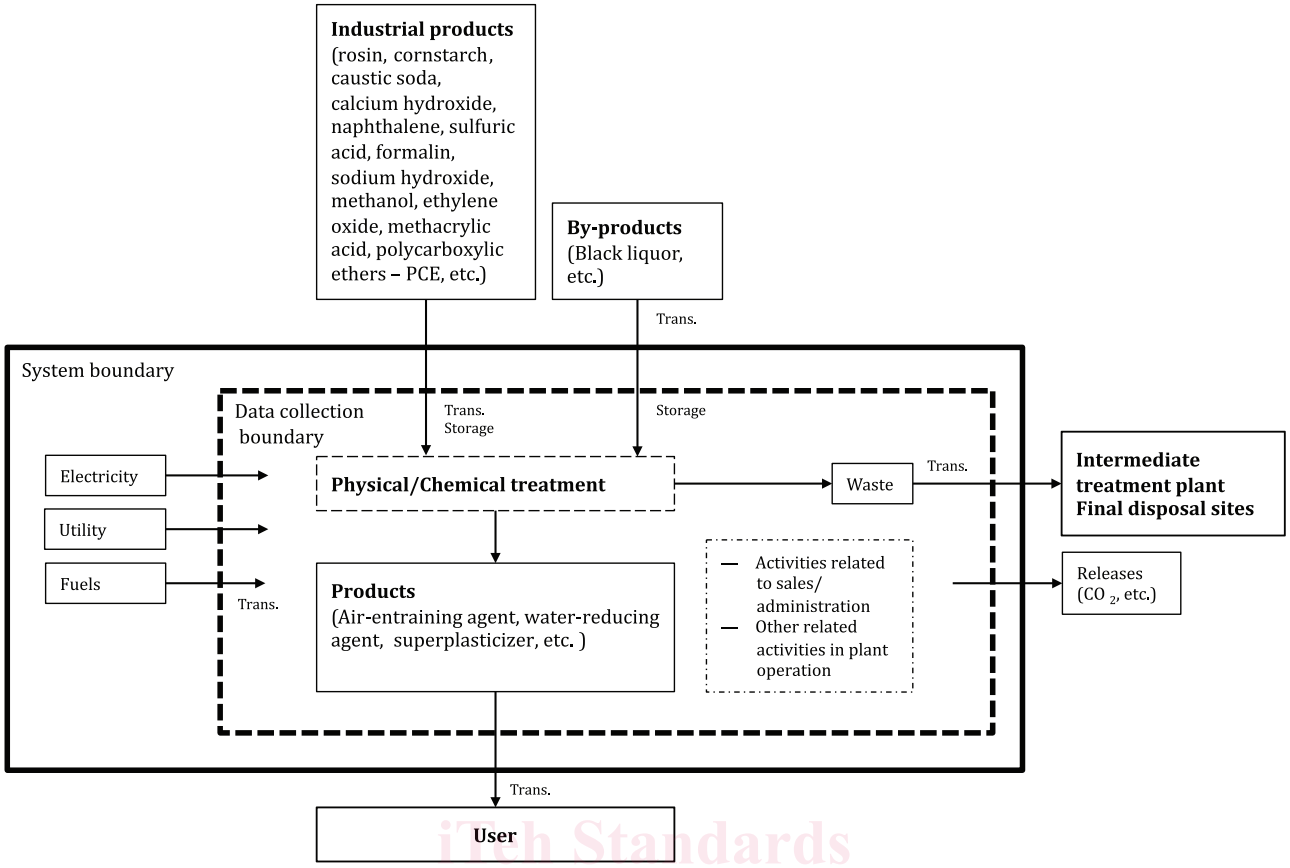
Since the combinations of raw materials for concrete admixtures widely vary, it is advisable to define the system boundary based on whether the raw materials are supplied at the expense of the user or the supplier.

Transportation of additions and admixtures from their production plants to the place of use shall not be included in the system boundary.



NOTE Activities related to sales/administration and/or other related activities in plant operation will possibly be considered.

Figure 3 — System boundary of additions



NOTE Activities related to sales/administration and/or other related activities in plant operation will possibly be considered.

Figure 4 — System boundary of admixtures

4.2.3 Aggregate

The system boundary and data collection boundary related to the production of aggregate is generally expressed in Figures 5, 6 and 7.

The system boundary for the production of aggregate shall include the following:

— mining and transportation of natural resources;

— transportation of fuels necessary for the production of aggregate;

— all processes related to the production of aggregate;

— transportation of waste generated in the process of aggregate production to intermediate treatment plants and/or final disposal sites.

The system boundary for the production of aggregate shall not include the following:

— transportation of crushed concrete and by-products necessary for the production of aggregate;

— transportation of aggregate from aggregate production plants to the place of use.