RESPONSE FORM

Standardization needs and suggestions to EURAMET for consideration in their 2017 EMPIR call

In the frame of the between CEN, CENELEC and EURAMET, CEN and CENELEC have been invited by the EURAMET Management to put forward their testing and measurement needs in **Industry**, in **Fundamental** and in **Pre- and co-normative research**.

Relevant technical groups (sector fora, advisory boards, coordination groups, TCs...) are invited to contribute with:

- a short introduction or an overview paper of their unaddressed standardization needs for testing and measurement, and
- a contact person (secretary, chair, convenor, liaison officer, etc.) whom proposers for the Potential Research Topics can contact,

using the table below, **before 12 December 2016**

Source of the identified need (identification of TC, WG, etc, incl. title)	☒ CEN/TC 193/WG 4 Building adhesives ☐ CLC/TC 000/WG 000 ☐ ISO/TC 000/SC 000 / WG 000 ☐ IEC/TC 000/SC 000 / WG 000 ☐ Other, namely *Identification, Title*
European entity responsible for submission of the need	*CEN/CLC TC #, or National Standardization Organization Title*
Person that can be contacted for more detail (name, e-mail and telephone number)	*Dr. Udo Windhövel* *udo@windhoevel-consult.de* *+49(0)26319570271* *GERMANY*
Unaddressed need (short description)	*European standard for the determination of the moisture content of screeds/subfloors*
Type of work (more answers possible)	☒ pre-normative ☐ SI-units ☐ co-normative ☐ interlaboratory study ☐ testing ☐ fundamental research ☒ measurement ☒ market support ☐ energy ☐ environment
Estimated effort (if known)	2 years Person months:
Further explanation of need (TC business plan, road map, formal decision, work item, etc.)	*With regard to European & globalized markets and rising international activities of constructors it would be desirable to have an European standard method for the determination of the moisture content of screeds/subfloors available. The direct measurement of the water content, which is the generally recognized code of practice in Germany seems not to be the method of choice as it is not accepted in most other countries, which is considered to be a barrier of trade.*

	Furthermore, material changes of cement screeds happened during the past 40 years and the market share of calcium sulphate based screeds with different compositions permanently increased. It would therefore be desirable to provide an European standard for the easy assessment of the dryness of subfloors prior to the installation of floorcoverings. The method should be independent from materials and applicable with available equipment.
Enclosures	☒ Yes ☐ No

Email address for sending the Response Form:

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Maturity of subfloors for installation of floorcoverings – Determination of the moisture content of screeds

1. Introduction

The determination of the moisture content of substrates is important to evaluate the maturity of subfloors for subsequent laying of a floor covering material, i.e. the assessment of the **dryness of a subfloor is an essential characteristic** with respect to the installation of a floor covering or parquet.

In Germany (and other German-speaking countries), the dryness of a substrate is usually evaluated by checking the "water content in Darr %" (kiln drying method) or "water content in CM %" (**C**arbide **M**ethod). The later is generally accepted to be the recognised code of practice in Germany (see TKB data sheet No. 16). In other countries, the determination of the "corresponding relative humidity" is state of the art to assure the dryness of a given subfloor. The later method has the advantage of working independently of the composition of the subfloor material (wood, concrete, cement screeds, calcium sulphate screeds....). In addition it easily gives an information about equilibrium condition, respectively shows in case of non-equilibrium condition in which direction a change will take place (from high humidity to low humidity).

There are different national standards available based on the measurement of the corresponding relative humidity. Roughly, you can differentiate between 3 principles of measurement:
a) measurement close to top (BS5325)
b) measurement in drill hole (NT Build 439, ASTM 2170)
c) measurement of samples taken from screed (NT Build 490)

However, there is no European or International standard available for an easy assessment of the moisture content (respectively the dryness) of subfloors/substrates in buildings, which can be used by craftsmen and technical experts on site.

2. Goals of the project

With regard to European and globalised markets and rising international building activities it would be desirable to have an European standard method for the determination of the maturity of subfloors before the installation of floorings in respect to the humidity or moisture content of the screeds or subfloors available. The direct measurement of the water content, which is the generally recognised code of practice in Germany, seems not to be the method of choice, as it is not accepted in most other countries. Furthermore, material changes of cement screeds happened during the past 40 years and the market share of Calcium sulphate based screeds with different compositions permanently increased. It would therefore be desirable to provide an European standard for the easy assessment of the dryness of subfloors prior to the installation of floorcoverings. The method should be independent from the material used for a given subfloor and applicable with available equipment.

To become broadly accepted by professional craftsmen and specifiers even in German-speaking countries, and to avoid further barriers of trade throughout Europe there should be given a proper correlation with thresholds/target values used so far.

3. Theoretical principles

3.1 Moisture from a thermodynamic viewpoint

“The term moisture or humidity characterizes the presence of water in or on a substance or in a glass or a room (e.g. the basement of a building). In physics and material sciences you generally speak of water content.“

Quantitatively the moisture respectively the water content can be described with means of thermodynamics.

Generally thermodynamic states can be described with different variables which are equivalent. These include either

- intensive quantity (variables independent of substance quantity, for example pressure or temperature) or
- extensive quantity (variables dependent on substance quantity, e.g. mass, volume).

Regarding the water content or the moisture, a typical intensive quantity is the so-called **vapour pressure** of water, which is given as **partial pressure** for measurements in the air. The partial pressure is often not directly measured as a pressure but determined rather as "relative humidity" in % of the **saturation vapour pressure** of the pure substance water in the air using special sensors.

Accordingly, the "**corresponding relative humidity**" means the humidity present in a relatively small volume of air around a "moist" object, which can be measured with appropriate sensors.

A typical extensive property of moisture for example is the amount of water in a given sample, which is then converted to mass related % or volume related %. Since different values for water content in mass % are obtained depending on measuring method, the readings are often given with indication of measurement method used. Darr-% is an information in mass related %, referring to the drying condition of the sample, often complemented by indication of the temperature present during the test, e.g. temperatures of 105 °C or 40 °C typical for screeds.

It is generally advantageous to use intensive properties when statements regarding the equilibrium of a system are required. Intensive properties must be equal in 2 or more phases of the contact equilibrium, extensive properties are not equal or if they are, this is only coincidentally.

For example: If two objects have the same temperature, they are in a thermal equilibrium and you can be sure that heat cannot be transferred from one object to the other. When two objects have the same amount of heat, no statement can be made whether the heat can flow from one object to the other.

When three materials containing water, e.g. screed, air and wood are in equilibrium in a closed system (e.g. in a tight stainless steel box), all three phases (wood, air and screed) will have the same vapour pressure relating to the substance water. This vapour pressure can easily be determined via measurement of the relative humidity, which for the screed or the

wood is then the "corresponding relative humidity". The process parallels the temperature measurement in contact equilibrium.

Once the intensive quantities are known, a direct statement can be made on the direction of the "flow", which will happen. For calculation of the new equilibrium condition however, extensive properties are also required, which can be determined from the intensive properties (see below, 2.2. Sorption isotherms).

3.2 Sorption isotherms

In principle, a relation between intensive and extensive properties can be derived. With regard to moisture, these relations are traditionally displayed as sorption isotherms, with mostly kiln-dry (German: “Darr”) moisture used as the extensive property and relative humidity as the intensive property.

Frequently, sorption isotherms are no simple functions but rather relations and show a more or less pronounced hysteresis for absorption or desorption. In particular, this applies to many materials used in the construction industry. In many practical cases which require a drying process however, knowledge of the desorption function is sufficient.

Sorption isotherms depend on the actual composition of a substance as well as on its microscopic and macroscopic structure, however all these parameters may change by ageing processes.

4. Extend of project

The project will at least consist of the following steps:

a. Preparation of screed specimens with different compositions
b. Determination of characteristic values for moisture, verification of humidity thresholds (kiln-dry, CM and CRH)
c. Evaluate all factors, which might influence the results. Study the following factors: (i) type of cement (ii) aggregate-cement ratio (iii) additives (iv) water-cement ratio (v) age of specimen (vi) sampling
d. Compare available test equipment for CRH
e. Compare available humidity sensors with regard to accuracy and robustness
f. Compare reproducibility of methods (Round robin tests)
g. Practical validation of CRH method (3rd party verification)
h. Summarise all results and develop a draft standard