SLOVENSKI STANDARD
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Ubežne in razpršene emisije skupnega pomena za industrijske sektorje - Ovrednotenje ubežne emisije prahu z reverzno disperznim modeliranjem

Fugitive and diffuse emissions of common concern to industry sectors - Qualification of fugitive dust sources by Reverse Dispersion Modelling

Fugitive und diffuse Emissionen von allgemeinem Interesse für Industriebereiche - Berechnung fugitiver Emissionsquellstärken aus Immissionsmessungen mit der RDM (Reverse Dispersion Modelling)-Methode

Emissions fugitives et diffuses concernant divers secteurs industriels - Estimations des taux d'émissions fugitive de poussieres par Modellisation de Dispersion inverse

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Foreword

This document (EN 15445:2008) has been prepared by Technical Committee CEN/TC 264 “Air quality”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2008, and conflicting national standards shall be withdrawn at the latest by July 2008.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This European Standard has been elaborated under a mandate of the European Commission/DG Enterprise to support essential requirements of the IPPC Directive (96/61/EC) and by voluntary action of industry.

The horizontal approach of common concern to industrial sectors is to gather industries concerned by diffuse/fugitive emissions and to develop methods suiting their needs. The industries of three trade associations have participated: EUROFER, EUROMETAUX and CEFIC. For practical reasons the two developed measurement methods, one for dusts and the other for gases are published as two separate standards. This standard has not been developed for Air Quality Control purposes and therefore shall not be used for monitoring by authorities.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies a Reverse Dispersion Modelling method to qualify the fugitive emission rates of diffuse fine and coarse dust sources of industrial plants or areas. The application needs calculations using a dispersion model, and the definition of a sampling experimental set-up taking into account field data such as number, height and width of diffuse dust sources, sampling distances, and meteorological information.

The RDM method does not allow quantification in absolute figures of the dust emission rates because of an undetermined accuracy depending on various site conditions, but it is a tool which enables each industrial plant to identify its dust sources that emit the most, and then to implement actions reducing their importance by self-control and related improvement process as part of environmental management.

In this framework, the RDM method should not be used to control or verify any compliance with air quality threshold global values which might be contained in an operating permit, or to carry out comparison between different plants belonging to the same industrial sector.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 12341, *Air Quality – Determination of the PM10 fraction of suspended particulate matter – Reference method and field test procedure to demonstrate reference equivalence of measurement methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
fugitive dust emission
uncontrolled dust emission to the atmosphere from diffuse emission.

EXAMPLE Windblown dust from stock piles, diffuse dust from workshop buildings, dust from handling dry bulk goods, re-suspension by traffic etc.

3.2
suspended particulate matter
SPM
notion of all particles surrounded by air in a given, undisturbed volume of air

3.3
PM10
fraction of SPM corresponding to a sampling target specification as defined in EN 12341

3.4
aerodynamic diameter (D_{ae})
to any particle, characterized by a physical diameter D_{ph} and a density, corresponds a D_{ae}: it is the diameter of a spherical particle of a specific mass of 1 g/cm^3, which would have the same limit falling velocity in undisturbed air

3.5
fine dust
fraction of SPM which particles display a physical diameter (D_{ph}) lower than 10 µm

NOTE If appropriate sampling devices are used, PM10 is applicable as fine dust, remembering that PM10 corresponds to the SPM fraction defined on the basis of aerodynamic diameter of particles (D_{ae}).

3.6
coarse dust
fraction of SPM in which particles display a physical diameter (D_{ph}) equal or higher than 10 µm. No upper limit is defined because the size of the suspended particles depends on the density of particulate matter

3.7
background dust
dust that is not related to the industrial activities of a plant, and generally coming from surrounding local and far-away sources outside the plant under investigation

3.8
dispersion factor α of a dust source
corresponds to the ratio between the contribution of a dust source *i* to the dust concentration (µg/m³) at a sampling location, and the emission rate *e* (g/s) of this dust source

$$c_i = \alpha_i e_i \qquad (1)$$

3.9
correlation coefficient, R_α
correlation coefficient obtained between sets of calculated dispersion factors of two dust sources; the value of R_α indicates if two dust sources are independent or not

EXAMPLE When a dust sampler is located between two dust sources, for the one located upwind the dispersion factor value is higher than zero (α>0) and for the other one downwind the dispersion factor value is zero (α=0). When the wind is blowing from the opposite direction, it is the reverse for α. Then their dispersion factors are not correlated.

3.10
correlation coefficient R_c between two sampling locations
correlation coefficient obtained between measured dust concentrations in two sampling locations; the value of R_c indicates the relative contribution of the plant dust sources and background dust

3.11
coefficient R^2_d of multiple determination
coefficient calculated from the multiple determination regression for a source. For each source taken into account, the value of R^2_d represents the fraction of the variations in measured dust concentrations (source contribution) explained by the dispersion model

$$c_{rd}(t) = \Sigma_i c_{ird}(t) = \Sigma_i \alpha_{irdt} e_{id} \qquad (2)$$

3.12
residue
difference between a measured dust concentration at a sampling location, and the calculated dust concentration at the same location by using the mean emission rate of each investigated dust source

4 Principle

Fugitive dust sources are not emitted at a fixed flow rate and the emitted matter is dispersed in air. In many cases, different dust sources contribute to the dust concentration in a sampling location.

Reverse-Dispersion Modelling is a method to obtain the mean emission rate estimation of each source by statistic treatment of:

— measured dust concentrations in different sampling locations;

— calculated dispersion factors α;
to solve this equation:

$$c_{rd}(t) = \Sigma_i c_{ird}(t) = \Sigma_i \alpha_{irdt} e_{id} \tag{3}$$

where

c_{ird} is the concentration of particles with the aerodynamic diameter d (equal D_{ae}), due to the source i at a sampling location r;

α_{irdt} is the dispersion factor of particles with the aerodynamic diameter d (equal D_{ae}), between source i and sampling location r;

e_{id} is source i emission rate of particles with the aerodynamic diameter d (equal D_{ae}), that we try to find out.

The dispersion of emitted matter is influenced by the location and geometry of the dust source, weather conditions, land roughness and the aerodynamic diameter d of particles. With an appropriate dispersion model and default emission rate e of 1 g/s, the dispersion factor α can be calculated in different locations around a dust source.

Contributions of different sources can be distinguished by simultaneous sampling in several locations, and calculation of correlation coefficient R_α between their sets of dispersion factors.

The measurements of dust concentrations comprise a background dust contribution which the exact origin is mostly not well known. Nevertheless areas shall be defined as potential background sources to be taken into account for calculations.

5 Measurement Equipment

5.1 Fine dust sampler

Devices used to measure the fine dust concentration at the sampling locations shall provide data with a sampling time resolution of 1 h, and shall collect the dust particles on a filter membrane (quartz fibre or PTFE) with a separation efficiency higher than 99,5 %.

If the device is not sampling PM 10 according to EN 12341, but a sampler which determines the proportion of particles with D_{ph} < 10 µm, a comparative measuring campaign with a PM 10 reference sampler shall determine a conversion factor to convert the D_{ph} data to D_{ae} data. (see A.1)

5.2 Coarse dust sampler

Devices used to measure the coarse dust concentrations at the sampling locations shall provide data with a sampling time resolution of 1 h, and they shall present a particle size resolution capable of distinguishing between three size fractions, preferably the physical diameter (D_{ph}) classes 10 µm to 30 µm, 30 µm to 70 µm and higher than 70 µm.

To obtain the corresponding D_{ae} size fractions data needed for the dispersion model calculations, a wind tunnel test shall be carried out for the dust under consideration, using an appropriate Tunnel Impactor, to determine a conversion factor allowing converting the D_{ph} data to D_{ae} data (see A.2).

6 Dispersion model

Dispersion models used to calculate the dispersion factors α shall be valid for the topological environment of the industrial area to be investigated.

The minimum requirements for the selection of the model are:

— locations, heights and size of the dust sources;

— particle size data where a distinction between particle size is required;

— locations and heights of the sampling locations;

— hourly data of wind speed, wind direction, stability of the atmosphere;

— hourly calculations of dispersion factor α.

7 Procedure

7.1 Experimental set-up

7.1.1 Dust sources location

The industrial dust sources to be investigated shall be defined (size, heights, nature, label …) and precisely located on a detailed map of the area. Additionally, background sources are defined, inside and surrounding the plant.

7.1.2 Sampling locations

The number and the locations of dust sampling depend on the location and number of industrial dust sources to be investigated. A minimum of two sampling locations are required for the emission rate estimation of one dust source.

The distance between the plant dust sources and dust samplers should be in the range 50 m to 300 m, depending on the density of the dust particles (chemical compound) of sources under consideration.

To distinguish different dust sources, it is highly recommended to select the sampling locations in between the plant dust sources, preferably on the axis of the most frequent wind direction.

The experimental set-up (locations of samplers) can be checked before beginning of dust sampling measurements by using the dispersion model and historical mean meteorological data for the measurement period (see 8.2.2 and 8.2.3)[1)]

7.1.3 Number of samplers and sampling campaigns

The number of sampling campaigns depends on the number of plant dust sources to be investigated and number of dust samplers available as one set for simultaneous measurements at different sampling locations. A set of two dust samplers as a minimum, shall be used.

Several cases are presented in Table 1:

1) The sampling locations and positioning of dust samplers may be dependent upon the plant services (i.e. power utilities).