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LABORATORY DUST LOADING TEST METHOD OF EXHAUST AIR TERMINAL DEVICES

Anne-Marie Bernard and Alain Ginestet – CETIAT - FRANCE
Marie Claude Lemaire – ADEME - FRANCE
Pascal Beltzer – EDF - FRANCE

SYNOPSIS

Loading of ventilation components with dust may affect air handling systems performances and contribute to poor indoor air. A lot of standardised test method for ventilation components characterisation - filters, fans, heat exchangers, extract air terminal devices etc. - exist but all these methods describe initial performance determination except for filters which are also characterised by dust loading test.

The aim of our study was to define a laboratory dust loading test method of extract air terminal devices and to validate results comparing to on-site results. As extract air terminal devices are commonly used in kitchens and bathrooms, dust loading may content solid particles and sticky particles.

Dust loading test results show a good reproducibility. Air flow measurement of naturally loaded devices show that the visual appearance can be not representative of the loading level. Naturally loaded devices show a large diversity but the loading effect is of the same order as artificial loading. Bathroom loadings, generally less sticky, can be represented in average by an artificial test with ASHRAE dust (EN 779) only while the adjunction of oil represents better kitchen loaded devices. Performances of the cleaned devices are similar to those of the new one except in case of very high loading characteristics.

KEYWORDS

Ventilation Performance - Indoor Air - Dust loading - Air Terminal Device.

MAIN TEXT

The aim of our study was to define an accelerated laboratory dust loading test method of fixed, self-regulating or humidity controlled extract air terminal devices and to validate results comparing to on-site results.

One of the most important parameter regarding dust loading test is the choice of the dust. As extract air terminal devices are commonly used in kitchens and bathrooms, dust loading may content solid particles and sticky particles.

We have therefore decided to study the influence on the results of the amount of oil particles within a mixture of ASHRAE test dust (EN 779) and oil mist aerosol (20 and 50 % in mass).
Dust loading test consists in to measure air flow rate passing through the device as function of dust fed (200 mg/m³) while pressure drop is kept constant (100 Pa).

Regarding the normal working position of the devices, it was decided to built up an horizontal test rig although this solution imposes to characterise sedimentation of particles in the measurements facilities.
Aerodynamic tests of all terminals have been tested previously to and after the dust loading and also after cleaning.
The test rig which has been used for the loading is described in *figure 1*. Air flow through the test rig is produced by using the fan installed downstream of the rig ; this fan is connected to a frequency controller.

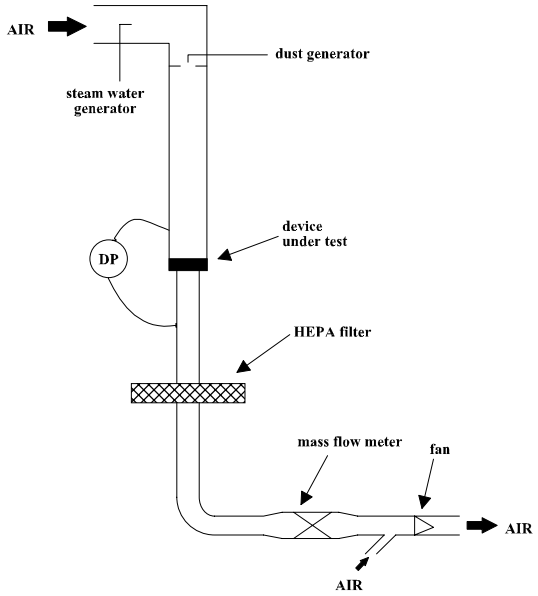

figure 1. Schematic diagram of test rig used for loading of the devices.

For humidity controlled devices, relative air humidity is controlled by using steam generator located upstream of the test rig. Relative air humidity is measured at the outlet of the test rig with a dew point sensor. Air temperature is also measured at the outlet of the test rig.

Air flow rate measurement is carried out with a mass flow meter located at the outlet of the test rig. By using the frequency controller, air flow rate is adjusted in order to keep pressure drop of the device constant (100 Pa).

Inner dimensions of the test rig are 250 mm x 250 mm (square area) upstream of the device under test, while circular area (125 mm in diameter) is used downstream according to the standardised outlet dimension of the devices.

Dust loading test consists in to measure air flow rate passing through the device as function of dust fed (concentration 200 mg/m^3) while pressure drop is kept constant (100 Pa). Loading dust is the well known ASHRAE test dust (used for loading of air filters for general ventilation) which is a mixture of silica fine dust (ISO 12103-1 grade A2), black carbon and cotton linters. Oil mist may also be added in order to define a mixture made of dry and sticky particles. Test

dust are fed continuously within the test rig upstream of the device under test by using compressed air generator. A typical example of results is given in *figure 2*.

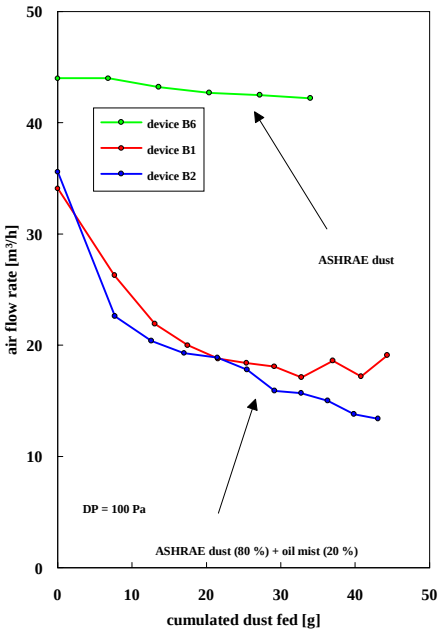

figure 2. Example of dust loading test results.

Dust loading test results show a good reproducibility (*figure 2*). No variations in air flow rate are observed when using ASHRAE dust only while a sharp decrease of air flow is reported when adding oil aerosol to the loading dust. Yet, when tested aerodynamically, more hysteresis has been noticed for some self-regulating exhaust grills. In this case, the regulation mechanism has been touched. Decrease of airflow is due to the loading of the passage area and is more pronounced when oil made the dust more sticky.

Air flow measurement of naturally loaded devices show that the visual appearance can be not representative of the loading level (*photo 1* and *photo 2*). Naturally loaded devices show a large diversity but the loading effect is of the same order as artificial loading. Bathroom loading, generally less sticky, can be represented in average by an artificial test with ASHRAE dust only while the adjunction of oil represents better kitchen loaded devices.

Adding of oil even with low mass percentage tends to increase strongly the loading effect.
Performances of the cleaned devices are similar to those of the new one except in case of very high loading characteristics.

These general results are driven from tests on :

- Self-regulating exhaust terminals,

- Fixed,
- Humidity controlled.

photo 1. Example of artificially loaded exhaust terminal (self-regulating).

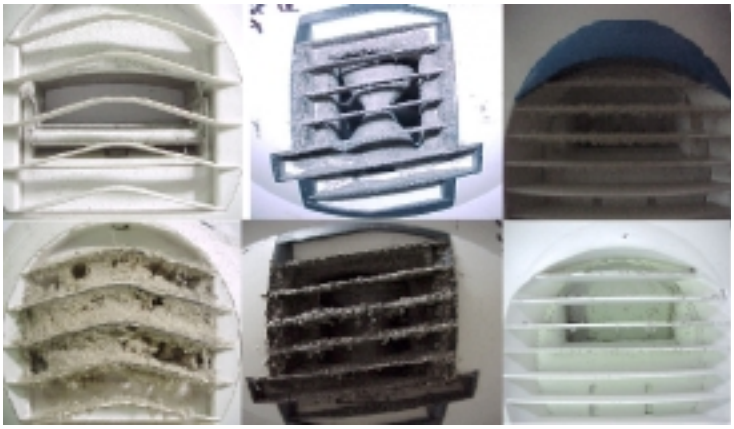

photo 2. Example of "on-site" loaded exhaust terminal (self-regulating).

On all terminals, the method of artificial loading can be used and has been checked to be similar to the range of effects obtained on "on-site" terminals. The possibility to test quickly (1 day) new terminals on their reactions to dust loading is a real improvement for the development of new products, designed to be less sensible to dust. The conclusion to this study is that the method is validated, reproducible and as much as possible representative. Due to sedimentation of dust within the test rig, only results tested at same airflow can be compared.

ACKNOWLEDGEMENTS

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