Indoor Air Quality Standardization in Ibero-America[1]

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General public is well aware that outdoor air quality in many European cities is bad and definitively affect our health and wellness, however, unless the well-known fact that urban population spend more than 90% of the time indoors, much less attention has been addressed to indoor air quality compared with outdoor.

We spend time working in commercial buildings, enjoying leisure time in hotels or shopping malls, or using services in hospitals and transportation centres.

Do we know the air quality in those places? Is it under control? Generally speaking most people assume that air quality indoors is good regardless outdoor air quality. Experience shows something quite different.

Countless scientific studies have shown that indoor pollution reflects outdoor, more or less exactly depending on the degree of air ventilation and infiltration, plus a large number of other pollutants added in the indoor air due to the activities, materials, people presence, biological activity, etc. Therefore, typically indoor air tends to be worse than outside.

There is a lot of knowledge about this problem, however, there is a lack of practical application of most of this information in every day's life for general public, the managers of the facilities do not apply, generally speaking, rigorous protocols and maintenance programs intended to enhance indoor air quality in their installations.

Any effort dedicated to control the quality of the indoor air will have undoubtedly enormous social benefits in terms of comfort and health of the population, enhancing productivity and minimizing absenteeism in commercial premises or diminishing nosocomial infections in hospital environments.

[1] This article refers to a pre-standard in Public Review, the pre-number is NIbF 400001 (Norma Ibero-Americana FAIAR) Indoor Air Quality Inspections.

Indoor Air Quality in Spain and Ibero-America

Indoor Air Quality is a relevant topic in Spain. A couple of decades ago media showed a lot of interest in episodes of so called "Sick Building Syndrome", Legionella outbreaks are, unfortunately, somehow common in Spain, or problems due to presence of *Aspergillus spp* in hospital environments and more recently health effects of asbestos, all these issues created general public awareness.

Probably due to such social awareness, since April 2013 Spanish main legal regulation dealing with HVAC systems established the compulsory obligation of carrying out yearly full inspections of Indoor Air Quality in buildings equipped with thermal installations holding a capacity above 70 kW (either heating or cooling).

The obligation is based on a set of standards previously developed by AENOR through a specific Technical Committee established in 2004 dealing with Indoor Air Quality, (TC171). Most of the effort in developing these standards have been managed by FEDECAI (Spanish Federation of Indoor Air Quality).

Portugal has also been a pioneer in Europe introducing IAQ as one of the topics to consider in Energy Efficiency certifications.

Other countries in South America, like Brazil also count on the obligation of analysing periodically IAQ in their buildings, and Colombia, probably Chile and others will soon follow this path. Representatives of those countries have actively participated in the development of the standard.

FEDECAI in conjunction with ATECYR (Spanish HVAC Association) reached an agreement with FAIAR (Ibero-American Federation of HVAC) in order to develop some harmonized Iberomerican Standards aimed to serve as a model that could be used by all the countries in the development of their own standards and also be used to train professionals specialized in Indoor Air Quality, being able to carry out IAQ inspections and apply solutions to the potential problems that might be found.

General considerations

In the last decades sustainability of buildings is becoming a prerequisite, no new structure is built without considerations of energy use and outdoor environmental impact, however, energy saving and environmental impact must be balanced with the need of a proper IAQ delivery.

The general workflow of the process is described in **Figure 1**.

The initial step is to identify all relevant aspects that may affect Indoor Air Quality in the building, the standard includes a list of some aspects that must be typically considered in a most buildings:

- Location of the building
- Uses and activities
- Construction and decoration materials
- Building Installations
  - HVAC
  - Water
  - Sanitary installations
  - Fuel tanks
  - Lifts and escalators
- Park areas
- Warehouses and special rooms.
- Maintenance of the building
- Refurbishment of the building
- Emergency (water and fire damages)
- Users complaints, epidemiological data, etc.

The objective of the inventory and subsequent assessment is to identify all potential IAQ adverse effect that may arise from different sources, each aspect is evaluated, considering the level of damage a situation may pose (consequences) and the likeliness that such event might happen.

For example, a typical IAQ aspect is the garage, a building having an underground garage indicates a potential serious risk, but the likeliness of fuel exhausts from the vehicles entering the building is low if the garage is properly separated (double access doors) and equipped with well-maintained exhaust fans connected to CO sensors, or it might be high if it is an old building with direct escalators connecting to the garage.

Indoor Air Quality Inspections

The inspection standard establishes a minimum set of parameters that are considered as general indicators of the Indoor Air Quality of any building:

- Inspection of hygiene of HVAC system (including ductwork test: surface microorganisms, gravimetric analysis of settled dust)
- Carbon dioxide and carbon monoxide
- Temperature and relative humidity
- Particle concentration and counting
- Airborne fungi and bacteria
- Carbon dioxide is used as an indicator of the quality of the ventilation.

Particle reading is a good indicator of the quality of the filtration systems, concentration is a health concern, and particle counting is used as an Indoor-Outdoor reference.

Humans are a source of airborne bacteria, so typically indoor airborne concentration is higher than outdoor, this is a good indicator of the general hygiene of the building and also a complementary indicator of the quality of the ventilation.

Fungi is mainly pulled in the building from outdoor and it is a good indicator of the hygiene of the HVAC and the quality of the filtration system.

These parameters must be checked on a yearly basis according to the standard, but apart from this minimum, some other complementary parameters should be analyzed if relevant sources have been identified:

- Formaldehyde
- Ozone
- Volatile organic compounds
- Airborne fibres (asbestos, fiberglass, etc.
- Nitrogen oxides

The inspection standard also establishes the number of sampling points to be taken as a result of the formula:

$$P = 0{,}15 \times \sqrt{A}$$

P = Nº sampling points

A = Area under study

Inspectors must be qualified by fulfilling a specific IAQ training course including at least the following content:

- ventilation and air conditioning systems
- chemical contaminants in indoor environments
- microbiological contaminants in indoor environments
- physical factors in indoor environments
- assessment
- control methods of indoor environmental quality.

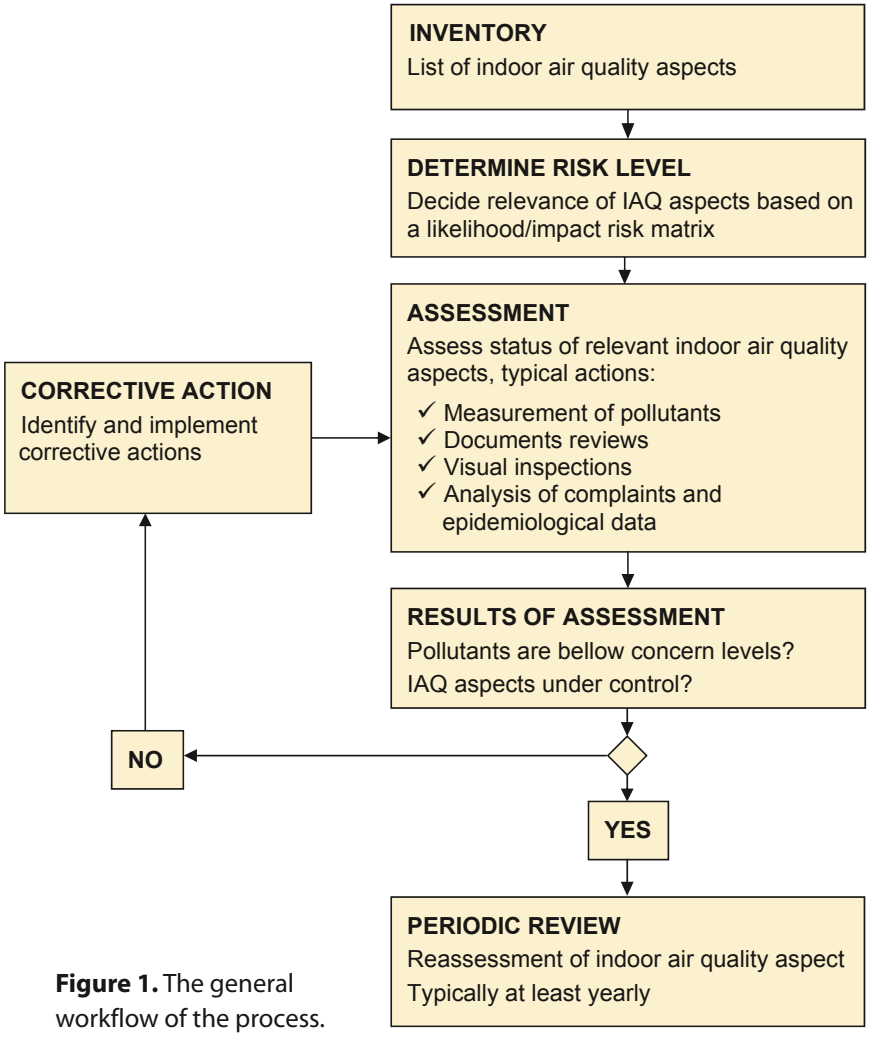

Figure 1. The general workflow of the process.

The purpose of the inspection is to achieve enough information to be able to declare conformity of the building as a whole. That means that it is not so relevant to find high readings of a specific pollutant in one single point, some basic statistical analysis apply, the building will be declared conform if 75% of the readings are below comfort threshold values, however, the standard specifies that it must be identified the cause of the non-conformities and corrective actions should be implemented.

Conclusion

Implementing IAQ control programs in buildings might suppose a major advance in the quality of the indoor air.

Building managers should ensure that the buildings are environmentally friendly, use energy efficiently and provide a healthy and comfortable indoor environment which is a benefit for the society not only in terms of better quality of life but also as a good economic investment. ■