Defining KPI for smart ventilation in the new French regulation

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ABSTRACT

In France, in Residential buildings, since 1982 the ventilation regulation imposes air flow rate to be continuously extracted from every room with humidity production. A boosted level of air flow rate shall be reachable in the kitchen. Since the mid-80s demand-controlled ventilation based on humidity level in each room has been allowed, provided that the system is validated by a national commission. In practice, for 40 years every new residential building has a mechanical ventilation system and 95% of them are centralised extract only systems. Since the beginning of the 2010s almost all of them have a humidity-based control. To allow the development of innovative systems that would be more energy efficient (hybrid ventilation, low pressure systems, etc.), the French ministry for construction has decided to create a new performance-based regulation for ventilation. A working group has been set up to define KPI for ventilation systems with the objective that innovative systems complying with those KPI meet the same level of performance as systems that comply with the existing prescriptive regulation.

The definition of those KPI and threshold values has followed the following approach:

1. *Define the objectives:* the performance indicators should show the impact of the air renewal systems on the Indoor Air Quality according to the following factors

Health: indicators should indicate the exposure (long term and acute) to pollutants emitted by buildings components and by human activities.

Well-being: indicators should relate the impact of systems on the sleep quality and the stuffiness in room.

Comfort: indicators should indicate the level of perceived air quality in the toilets.

Building damages: indicators should relate the risk of condensation that may lead to mould development.

2. *Define the basic principles:*

The performance indicators should be suitable for design, so the evaluation should be possible through simulation. Threshold values for those indicators should be consistent with performance of systems that respect the prescriptive regulation of "Arrêté de 82"

3. *Criteria and indicators*

For **health**, two parameters are used to evaluate the exposure: fictive pollutants P1 emitted continuously with an emission rate proportional to surfaces area and fictive pollutant P2 emitted during cooking events. The following is defined as indicator:

- For the long-term exposure:
  - the mean exposure of the most exposed person for P1
  - the percentile 95% of the P2 concentration in bedroom
- For the acute exposure
  - The maximum exposure over an hour for P1
  - The maximum value over an hour for P2 in the kitchen

The CO2 is the parameter used to relate for the **well-being** with the following indicators:

- The percentile 67% of the "worst room" during occupied periods for general stuffiness.
- The percentile 95% for peaks

Regarding **comfort** the minimum and maximum air flow rate in the toilet is the parameter used.

For the **building damage** impact, the frequency of RH above 75% during the heating period is used with different threshold values for kitchen, bathroom and other rooms.

4. *Verifiers:* Definitions of threshold and verification method

The verification of the compliance of a project to this new performance regulation will be done through simulations with a software called "MATHIS". To define threshold values more than 2000 simulations have been performed on dwelling equipped with ventilation systems compliant with the "Arrêté de 82": one is an extract only with fixed air flow rate and the other is an extract-only with humidity-based demand control system. The following

parameters are varying in the simulations: kind of dwelling, rooms area, room repartition, wind exposure, climate zone, airtightness level, ceiling high, for all of those parameters the repartition is statistically consistent with the French housing stock. Thresholds are defined in such a way that around 75% of simulations should comply with them.

KEYWORDS
Demand control ventilation, performance regulation, KPI