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ELIMINATION OF PRODUCT RELATED INDOOR AIR QUALITY PROBLEMS

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1. ABSTRACT: ELIMINATION OF PRODUCT RELATED INDOOR AIR QUALITY PROBLEMS

Indoor air has recently been a favourite among scientists. The research has even been succesful: our knowledge of the problems has increased remarkably.

Less attention has been payed on solving the problems. The progress in the knowledge has generated less progress in technology.

It has been claimed - and some evidence has been presented - that a ventilation system itself may be a source of IAQ-problems. Little has been done to analyze the problems, to indentify potential sources, and to eliminate them. E.g. guidelines of hygienic requirements are almost totally lacking.

In this paper are presented the first attempts to solve the problem. A Finnish project aiming to produce hygienic guidelines for ductwork is described. Also the first draft of a state of art report of product related IAQ-problems produced by Eurovent WG 12 is presented. The latter considers all components of ventilation system.

The European industry has recognized a gap between science and practice. The successful research has lead to few improvments in components and systems. It is suggested that an European project participated both by the industry and the scientists aiming to eliminate the product related IAQ-problems is started.

2. REGULATIONS AND STANDARDS

We have very strict and detailed regulations and standards considering what we eat or drink. The hygienic requirements for manufacturing, transport, stocking and sales of food and beverages are numerous, detailed and strict.

Very little care is taken of what we breath. Except rules for eliminations of legionella bacteria there are not standards or regulations for general hygiene and cleanliness of ventilation systems. My question is: is elmination of legionellas enough to quarantee the proper hygienic level of ventilation systems?

In the final (?) draft of the interpretative document "Hygiene health and the environment" of council directive for construction products (3) is said:

"I. GENERAL HYGIENE AND CLEANLINESS

1.2. Control of general hygiene and cleanliness

Unfavourable conditions may arise from:
- conditions that impair the normal cleaning and maintenance
- accumalation of dirt on surfaces
- inadequate measures for the disposal of waste or refuse.

Hygienic conditions may be controlled through:
- appropriate cleaning and maintenance programmes
- appropriate design of works and construction products, by providing easy access and operational conditions for cleaning activities and maintenance.

1.3. Technical specifications for construction products (cat B)

Harmonized tehcnical specifactions are required to cover the ability of construction products to provide easy access and operational conditions for cleaning activities and maintenance. Products for the lining of pavemtns, the construction of floors, and the inner surface of kitchens and toilets are concerned. Also building services such as ventilation systems where access for cleaning and maintenance is important.

Product characteristics are:
- chemical and mechanical resistance to normal cleaning
- resistance to climatic conditions (temperature, humidity)
- resistance to abrasion
- resistance to shock
- shape
- evenness
- dust adsorption, taking also account of static electricity if necessary
- moisture absorption.

Specifications are also required for products which must be kept clean at all times, such as those for food storage, preparation and cooking, products for toilets activities, excreta disposal and refuse disposal.

Product characteristics are:
- shape and size to facilitate cleaning
- hydraulic behaviour
- porosity. "

The listed standards might give a good base for remarkarble improvements in the hygienic level of ventilation systems. Unfortunately such standards cannot be prepared because the whole scientific base is lacking. Resistance to cleaning, climatic conditions, abrasion and shock may be specified in form of exact figures, but influences of shape and evennes as well as tendency to dust adsorption and moisture absorption are very poorly known.

3. PROJECT "HYGIENIC REQUIREMENTS FOR DUCTWORK"

A research project in order to develop design and installation guidelines and rules to cover the ability of ventilation system to provide easy access and satisfactory condition for cleaning and service was started year 1989 in Finland by Association of Manufacturers and Association of Cleaning and Service Companies.

Guidelines for the design of systems and components in order to decrease risk of dust accumulation, condensation, leakages etc. were decided to include in the project.

Relevant literature was studied and all available practical experience was obtained from cleaning companies. A draft standard to be circulated for comments was produced. The contents of the standard is enclosed.

At a very early stage of the work was observed that only rough qualitative recommendations may be considered. Any method e.g. to specify the quality level of and individual construction or compare two alternative constructions does not exist.

In figure 1 are presented alternative constructions of a 90° bend. Quite obviously number 1 is best because of its circular form and smooth surfaces. Cleaning the corners and guide vanes of number 4 is difficult and the risk of depostis is obviously much greater in alternative 4 than in alternative 1.

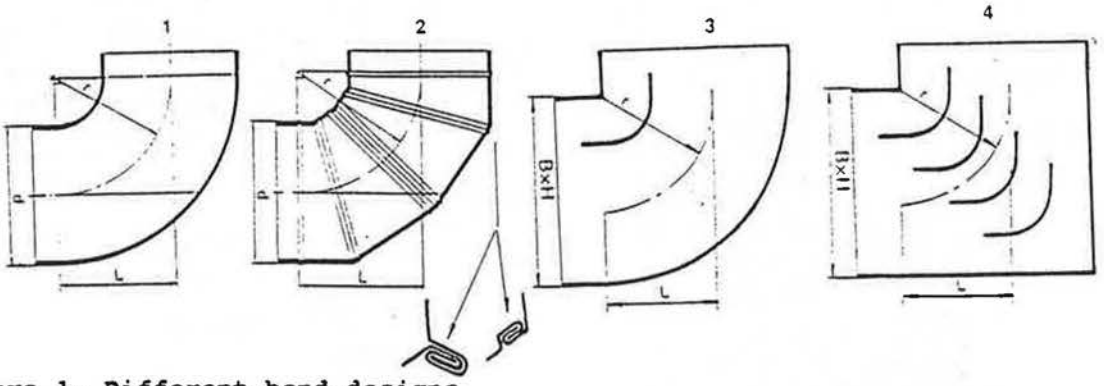

Figure 1. Different bend designs

Even in the most simple case of figure 1 we have no method to evaluate these alternative construciotns. We cannot even say, if alternative 4 is acceptable or not. Its recommended in many handbooks on base of low pressure loss. The cleaning presonnel has found that in practice they are often totally clogged, and they recommend prohibition of this alternative. It is, in addition, very difficult to clean.

The evaluation in this project was based on practical experience and common sense. The guidelines of good and not acceptabe practice (4) are given quite indefinitely and for quite evident cases only. The most important conclusion is that we need better methods to evaluate and test the risk of deposites in different components, constructions and practices.

4. EUROVENT-PROJECT "ELIMINATION OF PRODUCT RELATED INDOOR AIR QUALITY PROBLEMS"

Eurovent WG12, Indoor Air Quality, started the project in the beginning of the year 1990. Studies of relevant literature gave very little result. Problems are discussed and identified to some extent. The real origine of the problems is very poorly known and almost nothing is said of elimination of the identified problems.

However, it was decided to produce a state-of-art report of all Eurovent-products covering more than 90 % of components used in general ventilation. The work was devided among 7 authors, everyone specialized in a certain group of prodcuts.

The general feeling of the authors was again that very little exact scientific knowledge of the elimination of the potential problems is available. Rough guidelines are given for different products, but instead of research and tests, they are based on practical experience and common sense. Exact design methods, methods of evaluating and comparing constructions and - perhaps the most important one - methods of testing, are totally lacking.

Draft reports of components or groups of components were produced by nominated experts as follows:

Air handling units	Mr. Rodrigue
Air distribution	Mr. Railio
Filters	Mr. Macdonald
Humidifiers	Mr. Norell
Room and unitary air conditioners, fan coils	Mr. Roth
Cooling towers	Mr. Mager
Summary	Mr Becirspahic.

The draft reports we studied and critizized by the whole Eurovent working group 12, Indoor Air Quality. It was decided that Eurovent Technical Secretariat will prepare as an extract of the draft reports a state-of-art report "Elimination of product related indoor air quality probelms" (5), which has recently been circulated among group members for critics and proposals for revisions.

In addition, it was decided that for every product group will be developed a more detailed report in co-operation with relevant Eurovent working groups. This work has not started for the present.

The summary report gives, to some extent, even guidelines for practical design. In addition to what is listed in item 2 of this report, following common methods for control of hygiene and cleanliness are reported:

- improvment of filter efficiency
- elimination of filter by pass leakage
- avoiding condensation in cooling coils, especially in fan coil units
- protection of equipment during installation
- avoiding certain constructions, e.g. concrete and masonry ducts because of rough surfaces
- location of air intakes
- pressure relations in heat recovery units
- strategy of running a system, e.g. avoiding to close the system for nights and weekends

  etc.

However, the general opinion in the group was that we have no methods to estimate the risks of component or system designs, or to compare two alternative designs. We have no test methods and no theoretical base to relate results of existing tests to this problem. E.g. pressure losses of alternative designs quite obviously indicate also tendency to dust deposits, but we do not know the relations. We have no grounds to evaluate on which stage of pollution a ventilation system should be cleaned and no grounds to rate the result of cleaning either. The influence of surface roughness on dust adsorption, cleaning job and result of cleaning is not very well known.

In addition to technical points of view, even economical grounds are quite poorly known. E.g. costs of increased filter efficiency and, on the other hand, cost reductions due to decreased cleaning costs of ventilation system and the rooms it serves, has not been studied. A Swedish research (6) gives good reasons to believe that the rise and reductions of costs are, at least, in balance.

5. PROPOSALS FOR RESEARCH PROJECTS

It is quite obvious that our knowledge of the sanitation of ventilation systems is very limited. Merely the realization of the essential requirements of construction products directive is not possible without research work.

Many of the gaps in our knowledge is mentioned before. I have priorized the numerous potential subjects from the point of view of the industry as follows:

A. Development of a test method for the tendency of components to accumulate dirt on surfaces in order to cmpare different products and constructions. Reasonable costs and testing period are presupposed. The method should be verified with field studies in systems polluted in "natural" way.
   Exact scientific truth may probably not be achieved. The degree of accuracy is not very relevant. Maybe +/- 50 % might be enough for practical purposes. Even this level of accurace might help the industry to improve its products remarkably.

B. A research of the correlation of other product characteristics to the tendency of dirt accumulation. Potential indicators:
   - pressure loss
   - friction factor
   - surface roughness.

C. A research of the indicators to determine intervals for cleaning a ventilation system. E.g.
   - reduction of volume flow
   - increase of pressure loss of critical components.

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3. *Commission of the European Communites, technical committee essential requirements: Document TC3/018, Hygiene, Health and Environment, Brussels, 6 March 1991*
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APPENDIX

QUALIFICATION FOR CLEANING ADN FIRE SAFETY
SUMMARY

1. *FIELD OF APPLICATION*

2. *QUANTITIES AND SYMBOLS*

3. *CONSTRUCTION AND DESIGN*
   - *Construction methods to prevent the accumulation of dirt*
   - *Recommended, acceptabe and rejectable construction details*
   - *Consideration of cleaning in design and constructions*

4. *QUALIFICATION OF DUCTS AND FITTINGS*
   - *Standard sizes*
   - *Sheet thicknesses*
   - *Fire, sound and heat insulation. Protection of insulated surfaces*
   - *Consideration of cleaning*

5. *SPECIAL MATERIALS AND STRUCTURES*
   - *Flexible ducts*
   - *Plastics and other non-metallic materials*

6. *HANGERS AND SUPPORTS*
   - *Strength*
   - *Maximum spacing*
   - *Fire protection*

7. *ACCESS OPENINGS AND REMOVABLE FITTINGS*
   - *Minimum sizes for different duct dimensions*
   - *Location in ductwork*
   - *Construction, fire protection, removing and refixing*
   - *Space reservations for cleaning*
   - *Safety at work*
   - *Access openings for special equipment (e.g. fire dampers)*
   - *Removable fittings*

8. *TERMINAL DEVICES AND OTHER ADDITIONAL EQUIPMENT*
   - *Consideration of cleaning*
   - *Service, space reservations*
   - *Removing and refixing*
   - *Electric installation*
   - *Terminal boxes (convectors etc)*
   - *Silencers, heating and cooling coils, filters etc.*

9. *DUCTWORK FOR SPECIAL SPACES*
   - *Professional kitchens and grilles*
   - *Paintshops*
   - *Industrial and process-like spaces*

10. *DUCTWORK COMBINED WITH BUILDING CONSTRUCTION*
    - *Hollow slabs*
    - *Counter ceilings and floors*