Day-care centres and schools:
Healthy air for our children
The French indoor air quality observatory (OQA!) programme dedicated to the “Living spaces used by children” began in 2006. The first phase compiled literature review about pollution encountered in these living areas, time spent in them by children and the characteristics of existing buildings in France, to get a good understanding of these very heterogeneous places. Case-studies were then initiated to improve knowledge. Focus on results and follow-up.
This study was carried out in two collective day-care centres, a kindergarten, an elementary school, a secondary school and a high school in which there were no mechanical ventilation systems. Its purpose was to compare stuffiness, indoor air quality, comfort, and energy loss due to air renewal in a room (activity room or classroom) before and after installing a stuffiness light indicator. In all six buildings, knowledge of the stuffiness level based on a measurement of the concentration of carbon dioxide (CO$_2$) as a human effluents tracer, systematically changed the manner in which persons responsible for children managed ventilation by adopting different scenarios for the use of doors and windows (almost exclusively opening windows, opening indoor doors, etc.). The stuffiness indicator was fully effective and thus proved to be an excellent pedagogic tool.

These changes in behaviour led to fairly varied indoor air quality and energy consumption situations that reflected equally varied ventilation strategies. Although all ventilation strategies caused a reduction in the stuffiness of indoor air, they did not systematically improve indoor air quality as measured by all the studied indicators. The adopted strategies did not systematically lead to an increase in energy losses by air renewal, particularly when they involved airing by well-controlled opening of windows.

This work led to the development of a stuffiness index, so called “ICONE” (air stuffiness index for schools) and a tool (LUM’AIR) combining two complementary tools, firstly the direct calculation of the ICONE index and then a display of the state of stuffiness by LEDs.

The ICONE index provides information about the average state of stuffiness in a room taking account of both the intensity and the frequency of measured CO$_2$ peaks. It ranges from 0 (sufficient ventilation) to 5 (poor ventilation). The use of three light diodes to display stuffiness provides a means of managing situations encountered as they arise: if the light indicator is green, the environment is well ventilated and therefore windows can be kept closed; if it is orange, the environment is slightly stuffy, and it is useful to provide ventilation by opening windows (or doors) to reduce stuffiness; if it is red, then windows must be opened to improve air renewal in the room.
Follow-up… Deployment of the LUM’AIR tool on larger scale.

The LUM’AIR apparatus is currently set up in about a hundred classrooms in three French regions with contrasting climates (Ocean, Continental and Mediterranean).

The objective is to evaluate the acceptability of the occupants of the rooms and to optimise some functions so that it can be extended for use by many users in the future.

A fungal contamination index will also be evaluated in these schools at the same time. This index is based on measuring microbial volatile organic compounds emitted by the metabolism of moulds. It signals the presence of moulds even when hidden (for example, when mould develops behind a partition, in the building structure or in ventilation filters, or when contamination is recent and signs of development are not yet visible).

The ICONE index is also deployed in 300 schools and day-care centres as part of a pilot study coordinated by the Ministry in charge of Environment, for monitoring indoor air in these living areas.

Behaviour regarding ventilation: national study in schools and day-care centres

The OQAI began a national survey in January 2010 with about 2000 kindergartens and elementary schools and 1000 collective day-care centres representative of such buildings in France and drawn at random, to get a better understanding of what determines ventilation behaviour in schools and places occupied by young children. Five questionnaires were sent to each school for the attention of the headmaster and teachers and / or persons responsible for children. They are used to document the characteristics of doors and windows, ventilation habits and strategies, limitations to ventilate by opening windows and the wishes of occupants (modification of window types, automation or slaving of doors and windows, etc.). The results will be very useful for producing tools to better manage the air renewal in these premises (proposals for ventilation strategies appropriated for these buildings) and for future increased awareness actions.

The LUM’AIR light is orange: air is slightly stuffy, ventilation rate should be increased.
Exposure of children to indoor pollution: preparation of a national campaign

Like the national housing survey carried out between 2003 and 2005, the OQAI is preparing a national campaign for kindergartens and elementary schools in a representative sample of existing French schools. This campaign is intended to obtain in-depth knowledge of children exposure to air pollutants in these premises, including particles, volatile and semi-volatile organic compounds, aldehydes, metals, allergens, etc. Data currently available are either limited to aldehydes (particularly formaldehyde) or are restricted to a few schools in a few towns in France. Gathering these pollution data across the country will provide useful information for the evaluation and management of health risks in these living areas.

The investigation protocol (except semi-volatile compounds) is currently being tested in the context of a pilot phase in about fifteen schools in Clermont-Ferrand and its surroundings. Semi-volatile organic compounds (pesticides, phthalates, brominated flame retardants, etc.) are measured in air (gaseous and particle phases) and in dust deposited on the floor, in thirty schools in the greater Rennes district. The objective is to test protocols for sampling these so-called emergent compounds to obtain initial information about their potential presence in schools and eventually to judge whether it is relevant and technically feasible to include them in the national campaign. National deployment will begin in 2011.

Other studies ongoing in 2010...

Characterisation and quantification of microbial air quality in schools and day-care centres.

The objective is to get a better knowledge of airborne microbiological contamination in schools and day-care centres through the use of new molecular techniques that improve limits of conventional methods by culture. A first molecular inventory of biocontamination showed the presence of a wide variety of pathogenic bacterial species in the air of day-care centres. Starting from these initial observations, work is continuing in five collective day-care centres and five kindergartens, to get improved knowledge about children exposure to microbial content of air. The final objective is to propose an indicator for children exposure to microorganisms present in indoor air and that could affect health.

Contribution of cleaning products and school supplies to indoor air pollution in schools

The wide variety of products used for cleaning premises, for children's hygiene, and for activities is commonly put forward to explain occasionally high concentrations of volatile organic compounds indoors in schools and day-care centres. About twenty cleaning products and school supplies used in a kindergarten are currently being tested for VOC and aldehyde emissions, to provide initial information about the possible role of these products in the degradation of indoor air quality. At the same time, substances used in the composition of products are compiled, based on available documents, for example such as safety datasheets, in order to examine the extent to which this information can explain pollution situations encountered. If possible, they will be compared with data derived from tests in an experimental chamber. This exploratory phase will identify future needs (protocols designed specifically for the characterisation of emissions, database, etc.) and is very important for the control of indoor air quality.

Like the national housing survey carried out between 2003 and 2005, the OQAI is preparing a national campaign for kindergartens and elementary schools in a representative sample of existing French schools. This campaign is intended to obtain in-depth knowledge of children exposure to air pollutants in these premises, including particles, volatile and semi-volatile organic compounds, aldehydes, metals, allergens, etc. Data currently available are either limited to aldehydes (particularly formaldehyde) or are restricted to a few schools in a few towns in France. Gathering these pollution data across the country will provide useful information for the evaluation and management of health risks in these living areas.

The investigation protocol (except semi-volatile compounds) is currently being tested in the context of a pilot phase in about fifteen schools in Clermont-Ferrand and its surroundings. Semi-volatile organic compounds (pesticides, phthalates, brominated flame retardants, etc.) are measured in air (gaseous and particle phases) and in dust deposited on the floor, in thirty schools in the greater Rennes district. The objective is to test protocols for sampling these so-called emergent compounds to obtain initial information about their potential presence in schools and eventually to judge whether it is relevant and technically feasible to include them in the national campaign. National deployment will begin in 2011.
From research to action: OQAI results to provide risk management

OQAI's work is intended to improve knowledge about indoor pollution related to the comfort and health of occupants and the energy performance of buildings. Its main objective is to quantify and qualify pollutants and factors causing pollution situations (emission sources, aeration conditions, behaviour of occupants, etc.). The final purpose is to assess health risks and to suggest means of improvement to be applied by the stakeholders, and recommendations in terms of public policies.

The results of research initiated by OQAI contribute to various actions, for example monitoring of indoor air quality in spaces open to the public planned within the “Grenelle 2” law. The pilot phase of this future mandatory monitoring is currently being carried out in about 300 schools and day-care centres between autumn 2009 and spring 2011, at the initiative of the Ministry of Ecology. It includes monitoring of air stuffiness and the measurement of two indoor pollution indicators (formaldehyde and benzene) for which the health effects are well-known. A qualification of the building and its facilities in the form of a preliminary diagnostic will complete the monitoring system for this pilot phase.