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Distribution of 1000 free indoor air quality measurement kits to schools: kits as an alternative method proposed by the French regulation

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SUMMARY
Since 2015, the regulation on indoor air quality monitoring in schools in France has been modified to provide an alternative method to systematic measurements by laboratory by using kits sold on the market. Local authorities and school directors are allowed to use kits by themselves. Before that, they must identify the sources of the suspected pollutants using a national guide (INERIS, 2016a). In this framework, the MTES decided to distribute 1000 free air quality measurement kits to schools. Those are designed to measure two chemical agents: benzene and formaldehyde. It has been designed for non-professionals to carry out air sampling measurement easily according to a simple protocol and questionnaire. Over the 1000 kits distributed, only 2 results exceeded the regulatory limit values: one for each substance. Very few problems were reported concerning the use of this kit, and the repartition of results is similar to that of a previous measurement campaign carried out in 900 rooms in schools (2009-2011) but by professional laboratories thereby demonstrating its efficiency. This operation shows successfully that the alternative cheaper method proposed by the regulation allows to perform an indicative air quality measurement in schools.

KEYWORDS
Air pollution, indoor air, kit, benzene, formaldehyde, schools, alternative survey method

1 INTRODUCTION
Children are population sensitive to indoor air quality. They spend on average 90% of their time indoors each day. Many sources of pollutants in schools such as buildings materials, furniture, glue etc. can cause symptoms such as headache, irritation, tiredness… Since 2012, regulations on indoor air quality monitoring in schools in France have been published. They were modified in 2015 to provide local authorities and school directors with an alternative for estimate chemical agents by themselves using kits sold on the market. However, it is necessary for them to identify beforehand the sources of the suspected pollutants using a practical guide (INERIS, 2016a). In this framework, the MTES decided in 2016 to distribute 1000 free air quality measurement kits, developed and distributed by INERIS. This is the first time that air quality monitoring kits have been deployed at this scale in French schools.

2 METHODS
INERIS has made a kit that is both sampling and shipping box. This kit allows the measurement of the average concentrations using passive diffusion radial tubes over a week of two chemical agents: benzene and formaldehyde. They have been implemented by non-professional people through an illustrated user manual and a video tutorial specifically made to accompany their deployment. To be as representative of a long-term exposure of the children as possible, measurements were performed from Monday morning to Friday afternoon, *i.e* during 4.5 days (scholar holidays were not taken into account). The analysis of formaldehyde was performed by chemical desorption, followed by high performance liquid chromatography coupled with UV detection. The analysis of benzene was carried out by thermal desorption, followed by gas chromatography coupled with mass spectrometry.

3 RESULTS

Among 1000 distributed kits in one year (fev. 2016 to fev. 2017), 739 kits were sent back to the laboratory for analysis. The measured formaldehyde and benzene concentrations were compared with the guide values (30 µg/m^3 for formaldehyde and 2 µg/m^3 for benzene) and with the regulatory limit values (100 µg/m^3 for formaldehyde and 10 µg/m^3 for benzene). Remediation actions must be done for any observed level above the regulatory limit values (INERIS, 2016b). Concentrations of formaldehyde and benzene are detailed in Table 1.

Table 1. Concentration levels of formaldehyde (FA) and benzene (BE) (n=739 kits)

Concentration of FA (µg/m^3)	Proportion of results (%)	Concentration of BE (µg/m^3)	Proportion of results (%)
0 - 30	81.4	0 - 2	93.8
30 - 100	18.5	2 - 10	5.3
> 100	0.1	> 10	0.1

81% of the formaldehyde results were below the guide value. For benzene, 94% of the results had an average concentration lower than the guide value. These levels are satisfactory and did not imply specific actions. Among the kits analyzed, only two results exceeded the limit values: one for each substance.

4 DISCUSSION

This operation allowed to have a lot of results to confirm the mean levels of concentration in schools in France. The repartition of the benzene and formaldehyde concentrations are similar to those obtained during the pilot campaign in schools in 2009-2011 (n=900 results). Repartition of results showed that there are more results bellowed the benzene guide value than the formaldehyde guide value.

Among the analyzed kits, only less than 3% of tubes were invalidated because they were received broken either opened. Very few problems were reported concerning the use of this kit, thereby demonstrating the efficiency of this kind of tool for a measuring cheaper than when this measurement is done by a laboratory on site.

5 CONCLUSIONS

This deployment leads us to conclude that using kits to carry out air sampling measurement in schools can be done easily by non-professionals according to a simple protocol and questionnaire. So, this operation shows successfully that the alternative method proposed by the regulatory allows to perform an indicative air quality measurement in schools. Due to their simplicity and efficiency, this tool can be deployed for another kind of large scale studies and for any kind of pollutant wish can be measured by passive sampling.

6 REFERENCES

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