IMPACT OF KEROSENE PORTABLE HEATERS ON INDOOR CARBON MONOXIDE CONCENTRATIONS

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The purpose of this study is to quantify carbon monoxide (CO) indoor concentrations due to portable kerosene heaters in operation. We measured CO concentrations in 23 voluntary houses in Lille urban area (North of France), equiped with one or more portable kerosene heaters. Measurements were performed in each housing during two weekly periods (winter and summer).

INTRODUCTION

There are many sources of indoor air pollution in any dwelling places. They include combustion sources such as gas, coal, kerosene and cigarette's smoke. During a study carried out in North of France in 2001-2002, we measured CO, NOx and BTEX exposure of 60 volunteers in two urban areas (Lille and Dunkerque) [1]. The highest CO concentrations also measured were often involved portable kerosene heaters. To local authorities request, we carried out the present study to quantify more precisely CO concentrations in dwelling places equiped with portable kerosene heaters.

CONTEXT

Carbon monoxide is a colorless, odorless, non irritating gas produced by incomplete combustion. Every year, CO is responsible in France of about 6 000 acute poisonings, including 300 deaths, and an unknown number of chronic poisoning cases. Between 15 % and 20 % of these poisonings occur in Nord-Pas de Calais Region (North of France), which population represent only 6.7 % of the french population. Fight against CO poisoning is also prioritar task of Regional Health Authorities.

Dwelling places heating cost Increases have contribute to a growing of potable kerosene heaters market. These equipments have a major inconvenient : they reject combustion gases inside the housing (not flue). In the 2000 annual report of the poisoning regional monitoring network, they are designed as responsible of an increased level of acute CO poisonings in North of France [2]. In an other way, a study carried out by 380 general practitioner in South of France showed that these heaters could be the first source of chronic CO poisoning [3]. Aim of the present work is to investigate indoor CO concentrations due to portable kerosene heaters.

VOLUNTARY HOMES RESEARCH

First objective of this study was to find about 30 voluntary homes equipped with portable kerosene heaters, in Lille urban area (Nord-Pas de Calais first agglomeration). Voluntary call was first performed by the way of tracts, articles in local newspapers and APPA website. Study objectives were also presented to people involved in health prevention in Lille urban area, and to social workers, who helped us in our volunteer's research.

Unfortunately, only 23 homes were finally found. Reasons of these difficulties were analysed with our partners. First, portable kerosene heaters are forbidden in many housing (especially flats) by owners (especially council estate housing services) but this rule is not always respected by the occupants, even though we assure that the participation of our study is totally anonymous, a lot of people prefer not to claim they use such an heater at home! Another reason has been proposed by social workers : portable kerosene heaters owners are often people having financial difficulties. Indoor air quality seems to these families a “little” problem in regards to their focused preoccupations, such as food or heating.
But easy-use and economic image of portable kerosene heaters also seems attractive to other type of customers (among other, middle class). Principally, this is among us that we finally found our volunteers.

MEASUREMENTS PERIODS

Twenty-three voluntary homes in Lille urban area were equiped, during two weekly periods ("summer" and "winter"), of CO analysers (dräger Pac III, fig 1). Data have been collected concerning potential CO sources in the housing (outdoor sources such as industries or traffic, heating equipments, tobacco). Volunteers also completed, during the week, time-activity diaries (fig 2), by 15 min steps, concerning using of kerosene and other heaters, tobacco smoke, cooking, ventilation.

Fig. 1. Dräger Pac III

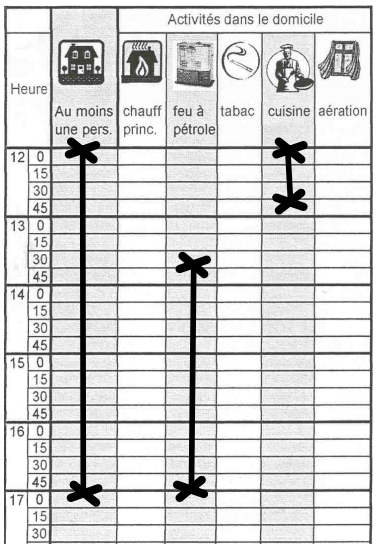

Fig. 2. time-activity diary

At the end of the second period (“summer”), we inform each volunteer about CO concentrations measured in his dwelling the first period (“winter”). At this occasion, information about CO risks were also given by project managers to the volunteers. The second period results were sent by post a few weeks after the end of the campaign, with an vulgarised abstract of principal results of the study.

MEASUREMENTS RESULTS

The 23 studied homes (majority of private housing) are occupied by 62 people and equipped by 32 kerosene heaters (ages and models very diverse). These equipments are mainly used as principal heating system (> 6 hour/day) whereas they are designed to be used as extra heater (fig 3).

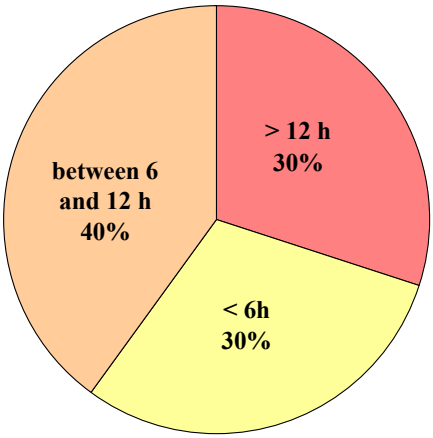

Fig. 3. Portable kerosene heater daily time using (winter period)

Among the 32 portable kerosene heaters, 11 were old generation and 21 of a new generation with safety electronic options (fig 4). First type was suspected to emit more CO than the second one, more sophisticated (and more expensive).

(a) (b)

Fig. 4: Two types of kerosene heaters: (a) old generation and (b) new one

Time-activity diaries have been used to rely CO concentrations measured with volunteers activities, and principally kerosene heaters using, as showed fig. 5.

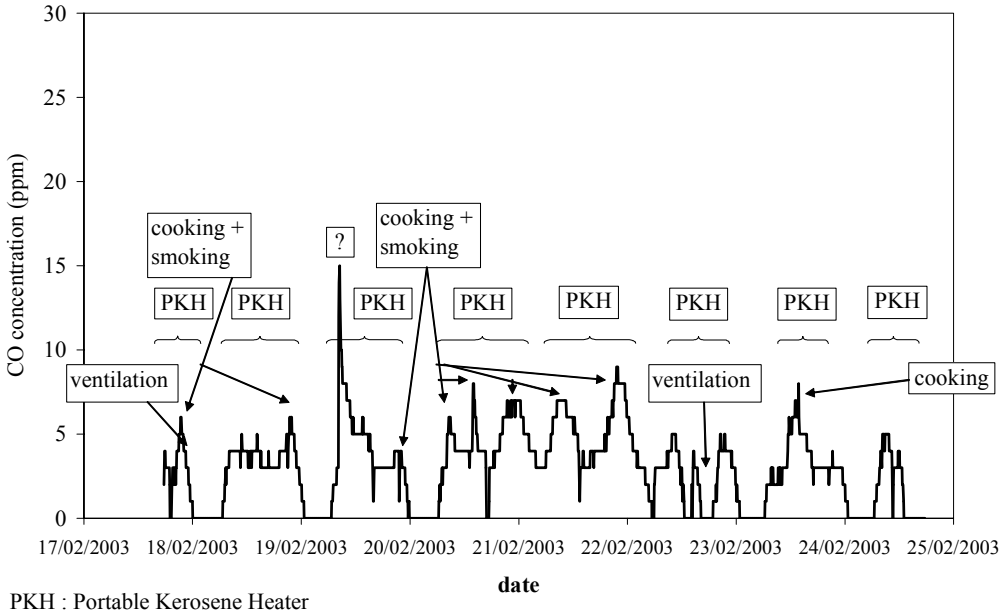

Fig. 5. CO concentrations (15 min averaged) during one week in regards with volunteers activities

In winter, weekly average CO concentrations on the 23 residences is 2.07 ppm. Distribution of weekly averaged CO concentrations is presented fig. 6. The 8 hours recommendation of WHO (10 ppm) was exceeded in 4 locations (17%).

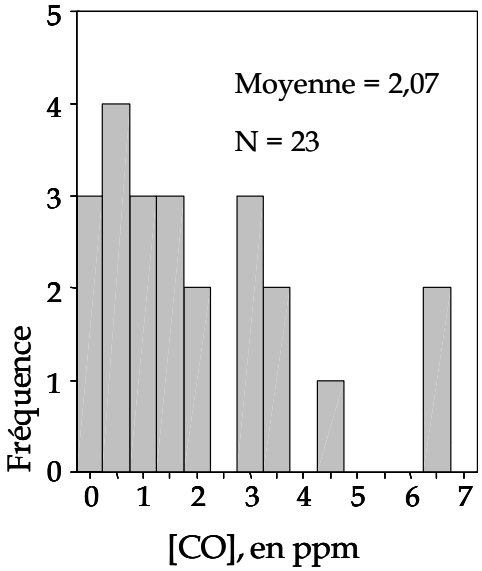

Fig. 6. Weekly averaged CO concentrations, winter period

CO levels emitted by portable kerosene heaters of our sampler are very diverse. Some of them emit very few CO: the six **lowest** CO concentrations measured during the winter campaign (hourly concentrations less than 1 ppm) involved **new generation** and **recent purchase**. But these new models are not always emitting less than the old generations, as we assumed before this study. Some of them could even be responsible of WHO recommendation exceedence.
Time using and maintenance of portable kerosene heaters seems to be the principal factors of CO **emissions: a kerosene heater usually used as extra heater** (1 or 2 hours per day), and regularly maintained seems emit just of few CO… But complementary investigations with a more important panel of portable heaters should be performed in order to verify this assumption.

IMPACT OF THE STUDY ON VOLUNTEERS PRACTICES

Even if 80 % of the volunteers claimed they had no advertises when buying their kerosene heater, a majority of them (70 %) think they **well know the CO poisoning risks**. It's quite surprising if we consider their usual practices:

- 70 % use portable kerosene heater as principal heating system, whereas they are designed to be used as extra heater
- many volunteers don't ventilate their dwelling
- 9 % of kerosene heaters are located in a bedroom
- 35 % of the kerosene heaters are running during volunteers are out of the house or (more dangerous) are sleeping

There is a **paradox** between volunteer's claims concerning CO poisoning risks and their common practices.

Following the campaigns, we asked volunteers about impact of their results on their practice of heating and ventilation in the future. All the volunteers claimed to be more aware to CO exposure problematic and 53 % want to change their practices of ventilation. However, 93 %

will continue to use their kerosene heater. In spite of an obvious awakening of the risks related to CO, the radical change of heating system is rare, mainly for economic reasons.

CONCLUSIONS

This study focused only on CO concentration but many other gases should be emitted by these portable kerosene heaters, including Organic Compounds as PAH [4], and the health effects of these products add to those of Carbon Monoxide. Portable kerosene heater marker growing, sale without salesman council, non-appropriate used should growing with too.

ACKNOWLEDGEMENTS

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