

Short report

Effects of extremely low concentration of chlorine dioxide gas on school children absent

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Chlorine dioxide (ClO₂) gas generators are used as indoor deodorants. We accidentally used a commercially available tabletop deodorant container that emits a very low concentration of ClO₂ gas as a deodorizer in a school classroom. Unexpectedly after use, we found that the classroom absence rate for 38 consecutive school days was significantly lower in classrooms with ClO₂ installed (1.5%) than in classrooms that did not install (4.0%). There was a significant difference between the absence rates (1.5% vs. 4.0%) in both classrooms ($p < 0.00001$). The main causes of absence during this period were colds and flu. Judging from the known virucidal activity of ClO₂, the findings we have unexpectedly discovered in the classroom evacuate respiratory viral diseases in the semi-enclosed spaces of theaters, hospitals, aircraft, etc.

It strongly suggests that a very low concentration of ClO₂ gas is useful in preventing the above.

Introduction

Chlorine dioxide (ClO₂) is a water soluble gas at room temperature (Gordon et al., 1972), tap water disinfectant (Betancourt et al., 2004), bleach (Moran et al., 1953), deodorant (Loesche and Kazor, 2002) has been used for a long time. Chlorine dioxide inactivates bacteria, fungi and viruses due to its strong oxidative activity (Berg et al., 1982; Morino et al., 2007; Roller et al., 1980; Simonet and Gantzer, 2006). The ClO₂ gas released from the aqueous solution is used as a sterilizing cleaner and deodorant for indoor air. We noticed an important finding about schoolchildren's absence when using a commercially available tabletop deodorant ClO₂ gas generator in the classroom. The threat of an influenza pandemic that will rapidly expand with air travel has recently become a major global concern. Briefly discuss the importance of our findings in preventing the spread of respiratory viral diseases such as highly pathogenic avian influenza in semi-enclosed spaces such as theaters, hospitals and aircraft.

Materials and methods

A commercially available desktop ClO₂ gas generator (Kreberin G, 150 g active ingredient container) was used. The components of the instrument are sodium chlorite (NaClO₂), sodium

dihydrogen phosphate (NaH₂PO₄), sodium salt of polyacrylic acid and water. This instrument continuously releases gaseous ClO₂. Three such appliances were installed as deodorizers in a classroom with a floor area of 65m² (capacity 230m³) and 34 schoolchildren. According to the manufacturer, when this number is used in a classroom of this volume, the ClO₂ concentration is 0.01-0.03 ppm. Data were collected at an elementary school age 6-12, with almost the same number of schoolchildren. Differences in the absence rate between the two groups (school children with and without the ClO₂ generator) were statistically evaluated by the χ^2 test, and the difference was considered significant at $p < 0.05$.

Results and Discussion

A comparative experiment was conducted with and without the ClO₂ generator installed in the school classroom (period: 38 consecutive days with classes from January to March). We have found that the absence rate tends to be lower in classrooms installed than in classrooms without ClO₂ generators (Figure 1). * Absence rate (number of absent school children in a specific classroom divided by the number of schoolchildren)
However, it was not clear from Figure 1 whether the difference in the absence rate between the two groups was significant in terms of materials and methods.

1. Cumulative number of school children attended or absent

| Cumulative number of school children | | |
|--------------------------------------|----------------|-------------|
| ClO ₂ generator | Attendance | Absence |
| Installation | 1,272 (98.5%) | 20 (1.5%*) |
| Not installed | 21,634 (96.0%) | 900 (4.0%*) |

The numbers indicate the cumulative number of school children who attended or were absent on 38 consecutive school days in classrooms (1 classroom) with or without ClO₂ generators installed (17 classrooms). * Significantly different ($P < 0.00001$, χ^2 test).

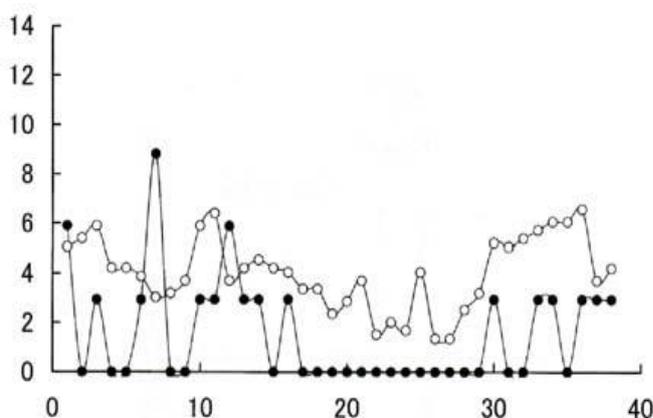


Figure 1. School absence rate. Absence rate in classrooms with a ClO₂ gas generator (black circle, 1 classroom) or classrooms with no ClO₂ gas (white circle, 17 classrooms) (number of classroom absent school children divided by the number of schoolchildren) is shown.

Therefore, based on the above data, the cumulative number of attending and absent schoolchildren was calculated by accumulating the daily number of attendance or absent schoolchildren on all 38 class days (Table 1). Compared to classrooms without ClO₂ generators, the absence rate indicated by the cumulative number of absent schoolchildren was significantly lower in classrooms with ClO₂ generators installed. The cumulative number of schoolchildren attending the classroom was 1,272 (98.5%) and the cumulative

number of absent schoolchildren was 20 (1.5%). On the other hand, in the classrooms that were not set up, the cumulative number of schoolchildren attended was 21,634 (96.0%), the cumulative number of schoolchildren attended was 900 (4.0%), and there was a significant difference in the absence rate (1.5% vs. 4.0%) ($P < 0.00001$, χ^2 test). This unexpected finding strongly suggests that the device is beneficial in preventing infections (probably mostly respiratory infections) in the community. In order to strictly prove the effect of low-concentration ClO₂ gas that prevents the occurrence of disease, it will be necessary to conduct a cross-over study in which the case where a ClO₂ generator is installed in the classroom of the same schoolchild group is alternately replaced. It will be necessary. Since the only volatile substances released from the equipment are ClO₂ and water, the effect of reducing the absence rate by installing the equipment seems to be due to the ClO₂ gas released from the equipment. Respiratory viral diseases such as highly pathogenic avian influenza are a major public health concern worldwide (Ginsberg et al., 2009). Traveling by air can cause such diseases to spread rapidly, which can result in a pandemic that can result in millions of deaths. However, there are currently few effective countermeasures against such strong infections in semi-enclosed spaces such as aircraft, trains, and school classrooms. Judging from the known virucidal activity of ClO₂ (Zoni et al., 2007), an unexpected post-hocological finding in this paper is to prevent the spread of respiratory viral diseases without the need for isolation. This suggests that extremely low concentrations of ClO₂ gas may be effective. Based on this finding discovered by chance at school, we conclude that very low concentrations of ClO₂ gas may prevent diseases such as respiratory infections in semi-enclosed spaces. A large prospective study with a robust methodology will be needed to demonstrate the important findings of this paper.

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