SUMMARY

Resistance of pathogens to the disinfectants used results in an increase in the number of infections. Spores and non-enveloped viruses occupy the top positions in the biocide resistance pyramid. The spore bacterium *Clostridioides difficle* R027 is considered to be one of the most resistant pathogens.

An important element in preventing the spread of pathogens is surface disinfection. Testing the biocidal effectiveness of surface disinfectants requires selecting effectiveness methods appropriate to the proposed product application. Moreover, it is necessary to determine the effective concentration of the biocidal substance. An important aspect is the product's impact on the natural environment.

The aim of the study was to examine the biocidal activity of disinfecting and cleaning-disinfecting preparations based on chlorine dioxide (ClO_2). The tests were performed in accordance with suspension and carrier standards. In order to determine effective ClO_2 concentrations, it was necessary to develop methods for its determination in the air and aqueous solutions, which contain organic components. In addition, it was performed an estimated toxicity and ecotoxicity analysis of the obtained products. Application tests were carried out on the disinfection of protective masks and X-ray apron exposed to gaseous ClO_2.

It was developed a method for determining the ClO_2 content in disinfecting and cleaning-disinfecting products. It involved a combination of: 1) voltammetric titration, of the ClO_2 basic standard solution and 2) spectrophotometric techniques, which involoves preparing a calibration curve (based on voltammetric measurement). The voltammetric method, was treated as an absolute reference method due to the impossibility of obtaining a ClO_2 standard. The determined molar absorption coefficient for ClO_2 in solution was $\varepsilon_r = 1288 \pm 16{,}9 \frac{\mathrm{L}}{\mathrm{mol*cm}}$.

It was developed a calibration of spectrophotometric method for determining the content of gaseous ClO_2 in the air. It was used the measurement of the specific spectrum of chlorine dioxide in the gas phase remaining in a state close to equilibrium with the ClO_2 solution. The advantage of the presented method is primarily the simplicity of determining ClO_2 in air, avoiding the use of complex gas generation systems and sources of potential calibration errors.

In terms of determining the ClO_2 content in the air, was made a comparative analysis of the concentration values obtained using the PortaSens III detector, with the values calculated by mass balance in the solution before and after the gassing process.

In preparatory research, were created five ClO_2-based biocidal products in the form of: concentrates: **Armex 5 MD**, **Armex 2000 Ultraczysty** i **Armex 5 vH**; foam: **Armex 5 foam**; and gel**: Armex 5 WC** with disinfecting properties (Armex 2000, Armex 5 vH) and cleaning-disinfecting properties (3 others).Their characteristic feature is, among others: stability in storage conditions, which was achieved thanks to the use of the *in situ* activation technique and short activation time for the recommended ClO_2 concentration - about 1 min.

The biocidal effectiveness of ClO_2-based preparations was determined in accordance with suspension and carrier standards intended for the medical area - the most demanding one. The research was conducted on pathogens strictly defined in the standards, i.e. bacteria, fungi, mycobacteria, spores - including resistant *Clostridioides difficile* R027 and viruses - including human coronavirus *229E*. A synergistic effect of ClO_2 and surfactants in the system was observed. It has been proved that effective concentrations determined using suspension methods don't give positive results in carrier research. In research of surface disinfection by air, it was proven that the biocidal effectiveness of ClO_2 depended on the relative humidity of the air.

The estimated analysis of acute toxicity, acute and chronic toxicity to the aquatic environment showed that products weren't subject to classification in any of the categories. The developed products can be considered safe.

An effective result of ClO_2 gas disinfection of protective masks was obtained after 2 hours of exposure at a concentration of 500 ppm*m*. For X-ray apron, a positive result was obtained after 4 hours of exposure at a concentration of 1000 ppm*m*. FTIR spectrometric analysis of the researched materials didn't show any damage.

The conducted research allowed to confirm the main thesis of the work. It was developed formulas of chlorine dioxide-based disinfectants, which are highly effective in reducing the spread of pathogenic organisms and have little harm to the environment.