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## **„HomeMade Explosives, development of procedures for hazard assessment, sample protection and disposal”**

### Abstract

In today's world, the issue of bomb threats is very topical. Government organizations, services responsible for security (including special services), armed forces, and response services such as the police (including bomb technicians), fire brigades (including hazardous materials specialists), and border guards make efforts every day to prevent or limit the threat effects. The constant race of these services and people whose goal is to threaten the community forces the former to take action to be always one step ahead of the latter in this armaments race. This race is a multi-level process, one of which is learning about the perpetrators' operation methods causing threats with explosives. Recognizing these methods impacts the possibility of preventing an attack in which random people may lose their lives or health. Since criminals know the security services' reconnaissance activities, they try to bypass security systems using all available methods. Because explosive is the essential element of every bomb attack, it is a constant target of interest for so-called "bad guys." In this matter, methods of secretly obtaining explosives are being sought. There are several methods of obtaining explosives, such as theft, illegal purchase, or removal of explosives from post-war remains or display pyrotechnics. However, one of the methods that explosive threats perpetrators increasingly use is to create an explosive from scratch. Explosives of this type are called "HomeMade Explosives" (HMEs) or "Improvised Explosive Devices" (IEDs). HMEs are produced by chemical synthesis or, more preferably, by mixing ready-made ingredients. Some of these ingredients are commonly available substances, legal in the form of pure chemicals or "hidden" in general-use products. Events worldwide show that the main explosives based on ammonium nitrate(V), potassium chlorate(V), nitromethane, or concentrated hydrogen peroxide contained products such as sugar, flour, sawdust, coffee, tea, etc. Awareness of this fact constitutes a sine qua non of all actions to neutralize the threat. Therefore, the current Ph.D. thesis aims to present the subject in a way accessible to all involved in the operation against the threat caused by IEDs. Considering the security services' manners and working conditions and that not all of their members have a strictly chemical education, there is a need to create a kind of guide that would present the subject matter in a simple and accessible way. The scientific and informal literature, the so-called "black books," were reviewed and analyzed; moreover, research was performed to verify the information provided in practice. Additionally, due to the need to develop methods for detecting HMEs, research aimed at demonstrating the possibility of determining the circumstances of the production of HMEs based on concentrated hydrogen peroxide. The possibility of examining the environmental presence of the traces of illegal chemical syntheses of three main groups of powerful explosives was also tested. The research results showed a great need for their continuation to profile further chemical substances, the possibility of using them to produce improvised explosives, and their detection methods. Unifying the study methods and giving a specific form for presenting the results is the key to creating a database on HMEs, which will be ready to use for each authority responsible for safety within the scope of its competencies and needs. Due to the need to develop HME detection methods, a line of research was proposed to verify the possibility of determining the circumstances of the production of HMEs based on concentrated hydrogen peroxide (so-called HPOM explosives). The performed research induced the need to analyze the possibility of recognizing HPOM-type mixtures, which developed the scope of subsequent research toward analyzing phenomena occurring inside these mixtures. Additionally, these mixtures were tested for the possibility of spontaneous combustion and potentially changing their composition caused by

the action of concentrated hydrogen peroxide on them as a function of time. Research has shown that defining markers of contact of food ingredients with concentrated hydrogen peroxide can be an element of forensic analysis. Considering the potential negative impact of explosives on the natural environment, it was proposed to investigate traces of illegally synthesized materials belonging to three main groups of high explosives in the natural environment using functionalized adsorbents. The research proved that the obtained porous adsorbents made of poly(2-oxazoline) can be effectively used for the selective adsorption of various explosive substances and for their quantitative determination in environmental samples using the FAPA-MS technique. The results of all the research showed a great need to continue to analyze further chemical substances and assess the possibility of using them to produce improvised explosives and methods of their detection. Unifying research procedures and giving a specific form for presenting the obtained results is the key to creating a database on HMEs, which each authority responsible for safety will be able to use within the scope of its competencies and needs.