

ZRÍNYI MIKLÓS NATIONAL DEFENCE UNIVERSITY
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***The Possibilities of Applying Mobile Ventilators
In the Process of Indoor Fire-fighting***

Short author introduction of the PhD dissertation

Budapest

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Advisor:

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THE SCIENTIFIC PROBLEM

Due to the dynamic progress of our age, the more and more complex industrial technologies, technical devices, our everyday objects, the synthetic materials which grain ground, the increasing transport and transit in the field of traffic, the more and more value-focused circumstances of our lives hide greater and greater dangers in themselves.

As a consequence, it is essential to keep developing the technical devices of the fire departments, to organize up to par trainings, and to adapt new fire-fighting and rescue methods based on the results of research.

Statements of the inland literature about a new, effective method used in the case of indoor fires, and my own practical experience at the fire departments led me to conclude that in Hungary, the mobile ventilation used in line with fire-fighting is less widespread. In the United States of America and in some countries of Western-Europe, the research of the applicability of this method is much more advanced, and they also have more experience in the field of practical application. To the best of my belief, in Hungary, the method is treated as morganatic, and in the lack of knowledge, it is used only at some fire departments, mostly only for the reason of gaining experience. So, it would be useful to adapt the results of the foreign research, to adjust them to the Hungarian circumstances and research on the subject to be able to declare our results for the sake of Hungarian practical application as soon as possible.

The experiences have not been documented or analysed, the method has not been analysed on theoretical basis and the terms of handing on the torch for later users has not been created so far.

While working on the new fire-fighting methods, besides the effectiveness, we must also aim to save our environment, since the materials used for fire-fighting, though in different measure, can cause harm to the environment. Consequently, it is necessary to choose such fire-fighting methods which cause no harm to the environment or if it does, only in the lowest degree.

So, when choosing the new fire-fighting methods, those ones should be more favoured which, besides their effectiveness or because of their effectiveness, are more environment-friendly. It is a basic rule that the fire-fighting (the fire itself is very

harmful to the environment) should not have any negative effects on the environment, or at least, it should cause as little harm as possible. The more effective the fire-fighting method is, the less time the fire has to be harmful.

The main topic of my dissertation is the most effective application of the ventilators used in the fire of community buildings, houses. The direction changing of the dangerous gases, its application in the fire of stadiums would be out of the boundaries of this dissertation, so I analysed them only to the rate of being able to understand things correctly.

OBJECTIVES OF THE RESEARCH

I considered as objectives of my research the followings:

- To prove that in the case of indoor fires, by applying mobile ventilation, the fire-fighting process is quicker and more effective, so the financial damage will be less, just like the cost of the intervention. Moreover, due to the shorter duration of the fire, its harmfulness to the environment will be also less.
- Considering the foreign and the Hungarian results and practical experiences, to research on the topic and considering these results to analyze scientifically the possibilities of applying mobile ventilators.
- As a completion of documents, to map out safety regulations for emergency, so that the fire-fighters who take part in the fire-fighting and rescue can perform their jobs not just effectively but also safely.
- To suggest the completion and modification of the Installation Rules published with the appendix of the BM-OKF measure.
- To suggest the completion of the Fire-Fighting and Technical Rescue Rules published as the appendix of the 1/2003. (I. 9.) BM statute about the rules of the fire-brigades' fire-fighting and rescue processes with possibilities of fume-exemption of medium-high and high buildings with mobile ventilators.
- By the establishment of the system of the fire-fighting and rescue tasks, to work out an intervention method for the sake of effectiveness and safety.
- To prepare an educational outline, that would help the local trainers on a daily basis with training well-qualified professionals.
- To attract the attention of the fire-departments to the availability of the device by the evidence of financial calculations.

RESEARCH METHODS

To achieve the given research objectives I applied the following research methods:

- when I prepared my study and research programme, I paid attention to that the compulsory and the chosen subjects, the research seminars would support my scientific aim as effectively as possible;
- I studied carefully the latest international and Hungarian research results;
- I had discussions with researchers and professionals who are familiar with the topic, furthermore I talked to potential Hungarian and foreign users;
- I prepared carefully planned unit fire-fighting and measurement experiments, and I summarized and evaluated the experiences.

BRIEF SUMMARY OF THE RESEARCH BY CHAPTERS

In the **first chapter**, I introduced the characteristics of the fires that arose indoor. After reviewing the basic burn - and fire-fighting theory, I analyzed the detrimental factors of the fire. I revealed, that due to the high temperature the fire causes in case of building-fires and to the toxicity of the smoke, what sort of harmful effects the fire has on the organic materials. Moreover, I also showed the detrimental effects it has on the building layouts. I demonstrated the dangers of two concepts less researched in Hungary – flashover and backdraft, which occur in case of indoor fires. I also presented the signs of the danger and the necessary tactics to apply.

In the **second chapter**, I summarized the foreign and the Hungarian experiences of using mobile ventilators simultaneously with the fire-fighting. After delineating the possibilities of ventilation, I reviewed the gist of applying “Positive Pressure Ventilation” By describing the conditions of applying mobile ventilation, I presented the differences of the traditional positive pressure ventilation and the turbo ventilation. I delineated the possibilities of the tactical application of mobile ventilation and I highlighted the favourable experiences of the Hungarian research.

In the **third chapter**, I presented my own unit fire and other experiments and I analyzed their results. When I made my unit fire experiments, I compared the results of fire-fighting with traditional devices and equipment with the results of fire-fighting with simultaneously used positive pressure ventilation. I also presented the results of

my mobile-ventilation experiments in smoke-free staircases (staircases without built-in smoke-exhausters). Based on my experiments, I contrasted the traditional positive pressure ventilation, which carries the same amount of air-power with the turbo-ventilator. I prepared an economical calculation in connection with the return of the costs of the application. In the end of the chapter, I reviewed the shortcomings I have found out in connection with the method.

In accordance with the revealed shortcomings, in the **fourth chapter** I worked out an intervention and safety regulation. I compiled an intervention method for the chiefs. I suggested the completion of the Installation Rules published with the appendix of the no.37/2003 BM OKF measures. I also suggested the placement of the mobile ventilators on the syringes of vehicles (which is the most common in Hungary). For the members of the fire station on alert, I made up an outline about the application of the mobile ventilation applied simultaneously with the fire-fighting.

SUMMARIZED CONCLUSIONS

Through the description of indoor fires and the examination of their characteristics, I pointed out an effectiveness-increasing method, which is accessible, among others, with faster and more effective ventilation. So, I researched on the effectiveness of ventilation methods applied simultaneously with the indoor fire-fighting, and I pointed out the advantages of positive pressure ventilation which is already used in Western-European countries.

By performing unit fire and other measurement experiments on different spots, I started to research on the effectiveness of mobile ventilation applied simultaneously with the fire-fighting contrasting it with the traditional fire-fighting methods. I experimented from the point of view of technical economy, safety of the fire-fighters and its effect on our environment. By contrasting the results of the unit fire experiments, I managed to prove obviously that due to the lower temperature and the better visibility, the fire can be fought more quickly by applying mobile ventilation.

When I performed my unit fire experiments, I contrasted the two methods not only from the point of view of temperature alteration, but I also measured the values of the variables that have effects on the organisms. After analyzing the measured values, in the case of both methods, I found out that 0,3 metres far from the floor, the 15%

volume percentage of the oxygen was always ensured, the temperature was never equal with or more than 50°C, and the concentration of carbon-dioxide was only hardly more than the dangerous value of 1-2 hour long respiration. So, essential differences between the two methods I could not find, at least from this point of view.

The unit fire experiments were carried out by the same fire brigade. Based on their reports, it became obvious that in the case of applying mobile ventilation, the fire fighters could intervene under better conditions from the point of view of both orientation and radiation of heat affecting them. I also proved that when mobile ventilators are in use, due to the low temperature, the spread of fire cannot occur.

Although I did not declare it as my research objective, but I observed that if the rate of the outlets is unfavourably big compared to the rate of the inlets, the necessary overpressure, and as a consequence, the appropriate airstream cannot come into being, so the ventilation will support the burning. This condition can exist from the beginning of the ventilation due to the incorrect exploration or it can come into being during the intervention when due to the high temperature, the expansion causes power, so as a consequence the windows break and the rate of the outlets increases. To define the phenomena, I introduced the concept of underventilation, in the case of which the application of ventilation raises the spread of the fire, so the effect will be just the opposite as our declared aims.

The other direction of my research was the method of making the stairways of high or medium high buildings free of smoke by the application of mobile ventilators. On the basis of my experiments I managed to be the first to prove by following the rules of the National Fire-Protection Rules, that if you want a stairway to become smoke-free, the inlets must be closed and you have to use mobile ventilators with high transported airpower to be able to ensure the necessary overpressure. By considering my experiments performed in stairways that fulfil the requirements of smokelessness, on the basis of my practical experiences, I drew the consequence that by using mobile ventilators in stairways full of smoke, the smoke spreading from the corridor can be removed effectively through the outlets.

Throughout my experiments I considered it as important to compare whether of the mobile ventilators transporting the same amount of airpower, but working in different ways which gives greater efficacy from the point of view of speed of the

airstream measured at the outlets. So, under the circumstances of an average block of flats I performed experiments, and I was the first to prove that turbo ventilators are more efficient than the traditional positive pressure ventilators.

I confirmed the results of my experiments with financial calculations. I proved that by using mobile ventilation simultaneously with the fire-fighting, the value of damage and the expense of the fire-fighting is less than in the case of fire-fighting with traditional devices. As most of the Hungarian fire brigades do not possess mobile ventilators, I considered it as important to prove that the supply expenses will return within a financial year for the autonomous fire brigades thanks to the decrease of the expenses of the fire-fighting.

Although I could not confirm it with financial calculations, I considered it as obvious that by applying mobile ventilation simultaneously with the fire-fighting, as it is a modern, environment-friendly method, the fire can be raked out more quickly, so the duration of the fire is shorter and as a consequence its harmful effect on the environment is shorter as well, moreover much less fire-fighting material (water) is needed.

I synthesized the results of my experiments, calculations and practical experiences and I found some deficiencies in the field of the efficient and skilful application of the device in Hungary. Based on it, as gap-stopping:

- in the form of intervention and safety regulations, for the people who use it, I created those guidelines, by the application of which, the mobile ventilators can be applied effectively and at the same time safely.
- helping the chief of the fire brigade, I prepared a decision-making method that can be used in every case of fire-fighting of indoor fires.
- I worked out the steps of the process of applying mobile ventilation simultaneously with the fire-fighting to complete the regulations of the Installation Rules published with the appendix of the no. 37/2003 BM-OKF measures.
- I suggested that the Fire-Fighting and Technical Rescue Rules published as the appendix of the no. 1/2003 (I. 9.) BM statutes about the fire-fighting and rescue rules of the fire service should be completed concerning the fume-exemption of the emergency routes of medium-high and high buildings.

- I highlighted the possibilities of placing the mobile ventilators on Mercedes-Rosenbauer TLF 2000 and 4000 vehicle syringes.
- I created an course outline including 15 lessons for the members of the fire station on alert, and I suggest to integrate it into the annual further-training of the fire stations.

NEW SCIENTIFIC RESULTS

1. On the basis of my own experiments and the experiences I managed to collect in the topic of mobile ventilation, I defined some cases, in which, because of the lack of the necessary conditions, mobile ventilation is forbidden, or because of the change of the necessary conditions throughout its application, it must be stopped.
2. With my experiments I managed to prove, that of the mobile ventilators which have the same effective air-transporting power but work in a different way, the turbo ventilator proved to be more effective, than the traditional positive pressure ventilator from the point of view of the speed of the airstream measured at the outlet.
3. Based on my unit fire experiments, I assigned the phenomenon of underventilation, so this recognition can help us to identify the situations in which the ventilation can cause the spread of the fire.
4. On the basis of my experiments, I proved that by applying heavy duty mobile ventilators in the case of the examined indoor stairway of the medium-high building, the necessary overpressure can be ensured, if the outlets are closed. Furthermore, if the stairway is impregnated with smoke, the ventilation can be carried out effectively.
5. Based on the results of my experiments, I made financial calculations, with which I proved, that by applying mobile ventilators simultaneously with the fire-fighting, the saved value increases, the costs of the fire-fighting decrease, so the supply expense of the mobile ventilator returns within a year of application.

6. Based on my practical experiences I gained in the topic of mobile ventilation, I elaborated on a decision-making method for the chiefs, and worked out a course outline for the members of the fire-station on alert as well. By their application, the intervention can be safer and more effective.

RECOMMENDATIONS

1. I suggest the completion of point 8, chapter 5 of the Installation Rules published with the appendix of the no. 37/2003. BM OKF measures with the things I elaborated.
2. I suggest that in the field of education of the members of the fire service on alert, the outline I have elaborated should be taken into account as well as the methods of practises in connection with mobile ventilation.
3. For the sake of more efficient fulfilment of the fire-fighting tasks, I suggest that the fire brigades procure and apply mobile ventilators introduced in my essay.
4. I suggest the further research of the possibilities of applying mobile ventilation in the case of fires of hall-like buildings, in the presence of dangerous materials, and intervention at tinderboxes.