

University of Medicine and Pharmacy, Târgu Mures
School of Doctoral Studies

**THE EFFECTS OF CHRONIC EXPOSURE TO IRRITANT GASES AND VAPORS
ON WORKERS FROM S.C. AZOMURES S.A.**

ABSTRACT

Scientific Advisor:
Prof. Dr. Zoltán Ábrám

PhD Student:
Zsuzsanna Ágnes Szász

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Introduction:

The present study aims to present the specificity of a local economic unit responsible for the most important industrial gas emissions in the area, the results of environmental evaluations and at the same time the working environment in comparison with the health of the working population and not only. All these are issues of major interest for the population of this county.

The most important emissions belong to the class of irritant gases and vapors, namely: nitrogen oxides and ammonia. In occupational poisoning caused by irritant gases and vapors the clinical picture is polymorphic. Exposure time until the onset of a disease can vary from minutes to hours in case of acute intoxication and in case of chronic intoxication from months to years. The irritant agent enters the body by interaction with the receptors of different tracts (mostly respiratory). The severity of toxic action depends on: *the concentration of toxic elements in the air, duration of exposure, and solubility in aqueous solutions.*

Aim and general objectives:

This study aims to answer frequent questions asked by the residents of the industrial area, particularly the citizens of Targu Mures, who live in uncertainty, because they do not know the extent their health can be affected by the emissions of the economic agent. As the most exposed group of population to these pollutants is exactly the one that works here, we aimed to corroborate the association of occupational exposure to irritant gases, vapors and dust: ammonia respectively nitrogen oxides and the incidence of pulmonary diseases/ alterations in their pulmonary function test.

Study 1 - The study of workers' health condition from the investigated plant exposed to irritant pollutants. The impact of chemical pollutants such as ammonia and nitrogen oxides upon health can be primarily studied in the large group of workers exposed to these emissions on a daily base for years. **Objectives:** Highlighting the clinical and paraclinical symptoms of the exposed subjects to irritants (correlated with environmental measurements), behavioral and lifestyle analysis regarding smoking as an aggravating factor in the development of chronic lung disease, the practice of different sports as correction factor, determining differences among units as a suspected aggravating factor (taking into account determinations performed in the

working environment, data provided by the industrial unit), the study of associations between disease and risk factors by the use of a control group for comparisons.

Material and method: *This study is a cross - sectional analytic one performed on a representative sample of 1900 workers during April 2010 - April 2011. The control group comprised 90 textile workers. Medical history, clinical examinations and the spirometry test were performed.*

Results and discussions: only 203 workers complained of different symptoms after being exposed to irritant pollutants and the most frequently occurring symptoms were the irritant phenomena of the nasal mucosa and/ or eye - in 38.5%. The spirometry test presented surprising results: 72% of the results were between normal limits and the diagnosed dysfunctions were in the same way obstructive (10,2%) and restrictive (9,3%) too. Smoking significantly contributed to the decrease of the forced expiratory volume/1 second (FEV) ($p < 0,0001$). The decreasing of FEV was also correlated with aging, but there was no association with the length of exposure. FEV values were significantly improved by practicing sports 2 - 3 times/ week. Investigating the 8 largest units of the plant there was one where FEV pathologic values were significantly different in comparison to the control group ($p = 0,0462$; $RR = 3,000$ at IC 95%). According to measurements at the work place this unit was not the most polluted unit and smoking was not significantly associated with the FEV decline.

Conclusions: Only 11,4% of the investigated workers presented symptoms at their work place. Smoking and aging contributed significantly to the decline of FEV, but the length of exposure was not relevant. In our study, regarding the decline of FEV values in case of chronic exposure to such irritants we found no statistically significant differences when compared to the control group, exposed to other pollutants.

Study 2 - Correlation of workers' health conditions in the surveyed chemical industry exposed to irritant gases and vapors in relation to the performed environmental determinations.

The specialty literature discusses not only the negative effect of irritant gases, vapors and dust on exposed workers' health, but also the effect of the intensity of exposure to such agents. **Objectives:** establishing the relationship between the incidence of declining respiratory function tests and exposure to high concentrations of ammonia; establishing a *short intermittent exposure time* to concentrations exceeding the MAC

(maximum allowable concentration) to irritant gases, vapors and dust that can cause *the decline of the spirometric parameters*. **Material and method:** a group of 346 workers was chosen, who were previously monitored (12 months – a relatively short period) out of which the **high exposure group** was formed with 150 workers and the **moderately exposed group** with 196 workers. A small group of 89 workers with **low exposure** were comprised in the control **group**. **Study:** a prospective longitudinal study of type exposed-less exposed individuals was performed. **Results and discussions:** during the study those workshops where MAC, NO_x (nitrogen oxides) and ammoniac emissions exceeded the normal limits were selected for investigations. The workers of these workshops were divided into two groups: high exposure (mean exposure of 7.17 mg/m³) and moderate exposure (mean exposure of 1.58 mg/m³) group. Regarding the index of bronchial permeability (IBP), there were significant differences between the groups in the first year as well as in the second year of study. In the high exposure group there was a significant decrease of FEV and IBP values during one year of exposure, while in the moderate exposure group only the IBP value declined. Mann Whitney U and Unpaired „t comparison tests were performed in the working environment for each VFT (ventilatory function test) parameter in the high exposure and control group (low exposure) – group of individuals coming from working environments which proved to be positive for ammoniac and nitrogen oxides. There were no statistically significant differences to the detriment of the high exposure group. **Conclusions:** We can state that the incidence of obstructive pulmonary diseases is increasingly higher from one year to another, fact that is influenced by the intensity of the exposure.

Study 3 - Short-term impact of coexistence powder gases and vapors irritating to the respiratory system. Studying environmental measurements provided by the industrial unit I was surprised by the intensity of dust pollution (total, respirable) in some workshops. **Objectives:** the study of short term impact (investigations performed during a similar period to the duration of exposition) of dust pollution on ventilatory function tests, subsequently the investigation of correlations between the alteration of ventilatory function tests and occupational exposition to irritant gases and vapors respectively to dust pollution. **Material and method:** The investigated lot comprised 532 workers

exposed to ammoniac and dust pollution from the studied industrial unit with the following composition: 1 group of 330 individuals undergoing moderate exposure to ammoniac and important exposure to dust particles – **group undergoing important exposure to dust particles (more exposed)** and a group of 202 workers with approximately the same exposure to ammoniac respectively undergoing less important exposure to dust particles – **group undergoing less important exposure to dust particles (less exposed)**. **Study:** an *analytical transversal study* was performed. Occupational history, general clinical examination, recording of ventilatory function tests were also performed (532 cases). **Results and discussions:** Comparing the mean values of functional parameters in the two groups there were no statistically significant differences. Although each measured parameter showed slightly lower mean values in the group more exposed to dust. Using an ICp = 95%, we calculated a $p = 0.5308$ and $RR = 1.037$ for establishing the differences of spirometry results in the two groups. **Conclusions:** The results were therefore interpreted as presenting no statistically significant differences between the number of individuals with altered VFT in the two groups.

Study 4 – New diagnostic methods applied when exploring exposed individuals to irritant gases and vapors. Material and method: We analyzed a group of 17 individuals who were not administered any bronchodilator treatment and/ or had no corticosteroid history, had no respiratory intercurrentence (status correlated with acute phase indicators of laboratory analysis) to explain the results of spirometry and who underwent body-plethysmography. The performed study was a descriptive transversal one. **Results and discussions:** All investigated individuals showed varying degrees of respiratory dysfunctions on simple spirometry test. Using plethysmography, has led to higher values of TGV (thoracic gas volume) and VR (residual gas volume) in 10 cases, with increased Raw values in 6 of them. As regards diffusion parameters disorders were found in 3 cases. **Conclusions:** Based on the above mentioned results, the presumptive diagnoses of the investigated workers was modified at discharge as follows: the number of individuals suffering from COPD increased from 5-10.

Final conclusions: We found no statistically significant differences in relation to the decline of VFT values in case of chronic exposures to these types of irritant agents in

comparison with the control group. The incidence of obstructive pulmonary disease in those investigated is higher from one year to another, fact that can be correlated with the intensity of exposure too. The short-term impact of coexisting dust particles with irritant gases and vapors on the respiratory system did not result in significant decreases of the functional parameters. Body plethysmography can be considered the best diagnostic method for a correct assessment of pulmonary diseases.

Key words: occupational exposure, nitrogen oxides, ammoniac, dust, body-plethysmography.