MINISTRY OF NATIONAL EDUCATION
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DOCTORAL FIELD: MINES, OIL AND GASES

DOCTORAL THESIS

- *SUMMARY*-

MANAGEMENT OF VENTILATION NETWORKS FROM PRAID SALT MINE

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CONTENTS

The research activity carried out in order to develop the thesis and for fulfilling the specific objectives is focused on two proposed vectors, namely through the use of the specialized IT equipment used for modeling, simulation and determination of the optimal distribution of the air flows within the mining objectives in operation, and optimization and simulation on complex air networks of virtual phenomena in order to ensure ventilation safety in the event of occurrence of fire-related phenomena and to ensure security from the ventilation point of view of Praid Salt Mine ventilation network in case of conscious volitional actions with dangerous gases which may occur in different areas of the underground mining network

This PhD thesis is structured on IX chapters, conclusions, personal contributions, bibliography and an annex. It includes a total of 247 pages containing 53 figures, one table and 6 annexes as follows:

Within Chapter I entitled ”Administrative localization of the salt deposit” a brief history of salt mining in Praid has been approached as well as a brief overview of geographic data.

Within Chapter II entitled ”Determination of the gas-dynamic regime and classification of Praid saline in terms of gas emissions (methane and carbon dioxide)” I approached the following issues: the technical memo of the salt mine, general considerations regarding the settlement and geology of the reservoir, the opening, preparation and exploitation of the deposit, the aeration system of the salt mine, existing records and documentation regarding the releases of gas, the results of the gas release study, underground mining, the results of the measurements made.

Within Chapter III entitled ”3D – Canvent description” I have approached the following issues: description, program features, 3d-Canvent applications, fan treatment, program features, building a ventilation model using the 3d-Canvent-2k program and its operation, branching data, fan characteristic, operating point and characteristic curve of the mine, 3D-Canvent operation with subchapters including ventilation simulations, simulation performance, visualization of simulation results, and balancing and graphic output of data.

Within Chapter IV entitled ”Analysis of the ventilation system of Praid salt mine in the current stage ” I approached the following issues: generalities, opening works, exploitation works in the New Sector and Telegdy Sector, work equipment, treatment base, air conditioning at the current stage and verification of the operation of the main ventilation facility.

Within Chapter V entitled ”Solving / updating the ventilation network of Praid salt mine ” problems such as: determination of the aerodynamic resistances of the mining works, updating of the Praid saline network scheme and solving the refurbished ventilation network of the Praid salt mine are addressed.

Within Chapter VI entitled ”Simulations performed over the ventilation network of Praid salt mine” are approached six simulations and issues:

6.1. Simulation no. 1 - airflow distribution, size and direction of movement throughout the salt mine ventilation system (normal current operating situation).

6.2. The distribution of air currents, the magnitude and the direction of movement throughout the ventilation system of the salt mine considered to reverse the direction of the main fan, the horizon + 339m.

6.3. Simulation no. 3 - Possibility of optimal fresh air supply of horizons + 448m and + 432m from the Telegdy mining sector (no condensation in the hot season).

6.4. Simulation no. 4 - The distribution of air currents, in size and circulation direction within the underground treatment base (horizon + 402m) and the underground restaurant (horizon + 426m), in case the partial ventilation fan from + 339m horizon stops.

6.5. Simulation no. 5 - The distribution of air currents, in terms of size and Direction, at the underground treatment base (horizon + 402m) and the underground restaurant (horizon + 426m), in case of reversing the partial airflow direction from the + 339m horizon.

6.6. The distribution of air currents, in terms of size and circulation direction, throughout the Praid Salt air system, under the conditions of a fire occurring on the extraction blind sfat, respectively at the + 339m horizon.

6.6.1. The distribution of air currents, in terms of size and circulation, throughout the Praid Salt mine ventilation system, under the conditions of a fire occurring on the extraction blind shaft between levels 246-266

6.6.2. The distribution of air currents, in terms of size and direction of circulation, throughout the Praid Salt mine ventilation system, under the conditions of a fire occurring on the extraction blind shaft between levels 266-286.

6.6.3. The distribution of air currents, in terms of size and circulation, throughout the entire Praid Salt mine ventilation system, under the conditions of a fire occurring on the extraction blind shaft between levels 286 and 340.

6.6.4. The distribution of air currents, in terms of size and circulation, throughout the Praid Salt mine ventilation system, under the conditions of a fire occurring on the extraction blind shaft between levels 340 and 426.

Within Chapter VII entitled ”Ensuring the safety at Praid salt mine from the ventilation point of view” the following issues are addressed: presentation of the VENTSIM Visual Advanced program, features of the VENTSIM Visual Advanced program and solving the ventilation network of Praid Salt mine.

Within Chapter VIII entitled ”Ensuring the safety at Praid salt mine from the ventilation point of view in case of fire type phenomena occurrence” are approached three fire occurrence scenarios:

Simulation 1: The occurrence of a fire on Gallery 617 A, horizon +30

Simulation 2: The occurrence of a fire on the extraction blind shaft between horizons +208 and +188.

Simulation 3: The occurrence of a fire on the emergency rising, between horizons +208 and +230.

Within Chapter IX entitled ”Ensuring the safety at Praid salt mine from the ventilation point of view in case of conventional voluntary actions with hazardous gases”

Chapter X comprises conclusions, personal contributions and future research directions as follows:

X.2. PERSONAL CONTRIBUTIONS

During the elaboration of the doctoral thesis the following personal contributions were detached:

- I researched and presented analytically aspects related to the history of salt mining in Praid salt mine;
- I have also introduced an important part related to the exploitation of salt in the underground, namely data of physical geography;
- I have developed and presented a technical memorial specific to the salt mining in Praid salt mine;
- I also briefly presented technical elements regarding the geology of the deposit;
- I also presented the mining works specific to the opening, preparation and exploitation of the deposit;
- an important part of my analysis was dedicated to the ventilation system of Praid Salt mine;
- I have carried out a detailed study of the releases of gas at the level of the active and inactive mining works of the Praid mine;
- I have carried out detailed technical measurements in order to establish the gas dynamics and the classification of the Praid Salt mine from the point of view of the gas emissions;
- also for the purpose of solving the ventilation network of Praid Salt mine, I have presented in detail the specialized modeling program 3D Canvent. It is a specialized program for the solution and optimization of the ventilation networks;
- an important part of my scientific approach was dedicated to the analysis of the Praid Salt mine ventilation system at the present stage;

- in this respect, I presented the opening and exploitation works specific to the New Sector and the Telegdy Sector;
- I also briefly presented technical aspects related to the work equipment, respectively the treatment base;
- for the modeling, solving and optimization of the Praid Salt Saltwater System, the following steps were taken:
    - obtaining general topographic maps in plan and at horizon level;
    - obtaining the spatial ventilation maps related to Praid Salt Mine;
    - establishing the nodes and branches of the Praid Salt Mine ventilation system;
    - developing measurement campaigns regarding the aerodynamic, electrical and state-specific parameters of the ventilation network;
    - obtaining geodetic coordinates specific to each node;
    - introducing geodetic coordinates into the program database
    - modeling of the ventilation network;
    - performing calculations for determining specific parameters in a manner compatible with the program database;
    - introducing the results obtained from the calculations into the program database;
    - balancing the ventilation network;
    - solving the ventilation network;
    - optimization of the ventilation network;
    - obtaining the results in the 2D and 3D graphic, respectively the tables;

- also for modeling and solving the ventilation network of Praid mine, I have determined the aerodynamic resistance at branch level;

- I have updated the ventilation network of Praid salt mine;

- I carried out 10 simulations on the updated ventilation network of Praid salt mine, as follows:

    - ❖ Simulation no. 1 - Distribution of air currents, in size and circulation direction, throughout the Praid Salt Mine ventilation system. This is the current normal operating situation;
    - ❖ Simulation No. 2 - Distribution of air currents, in terms of size and circulation direction, across the entire Praid Salt Mine

ventilation system. It was considered a reversal of the main fan's direction from the + 339m horizon;

- ❖ Simulation no. 3 - Possibility of optimal supply of fresh air to horizons + 448m and + 432m from the Telegdy mining sector Possibility of condensation during the hot season;
- ❖ Simulation no. 4 - Distribution of air currents, as size and circulation direction from the underground treatment base (402m horizon) and the underground restaurant (426m horizon). It was modeled in the situation when the ventilation fan from + 339m horizon partially stopped;
- ❖ Simulation no. 5 - The distribution of airflows in the underground treatment base (horizon + 402m) and the underground restaurant (horizon + 426m). It was modeled in the situation of reversing the partial airflow direction from the + 339m horizon;
- ❖ Simulation no. 6.1 - The distribution of air currents, in terms of size and circulation, throughout the Praid Salt mine ventilation system, under the conditions of a fire occurring on the extraction blind shaft between levels 246-266
- ❖ Simulation no. 6.2 - The distribution of air currents, in terms of size and direction of circulation, throughout the Praid Salt mine ventilation system, under the conditions of a fire occurring on the extraction blind shaft between levels 266-286.
- ❖ Simulation no. 6.3 - The distribution of air currents, in terms of size and circulation, throughout the entire Praid Salt mine ventilation system, under the conditions of a fire occurring on the extraction blind shaft between levels 286 and 340.
- ❖ Simulation no. 6.5 - The distribution of air currents, in terms of size and circulation, throughout the Praid Salt mine ventilation system, under the conditions of a fire occurring on the extraction blind shaft between levels 340 and 426.

- for the study of the safety of the air-conditioning, I have used the specialized program VENTSIM Visual Advanced;

- for this I briefly presented the structure of the program and VENTSIM Visual Advanced features;

- I have also solved the Praid Salt Mine Ventuiltion network with VENTSIM Visual Advanced;

- to solve the ventilation network of the Praid Salt Mine with VENTSIM Visual Advanced, I used the 3D-CANVENT database;

- for analyzing the Praid Salt Mine ventilation network in terms of quality assurance, I have used VENTSIM Visual Advanced. It was used to identify the changes in the air network in the conditions of occurrence of fire phenomena;

- in this regard, I realized a number of three simulations as follows on the updated ventilation network of the Praid Salt Mine, solved with VENTSIM Visual Advanced program:

-Simulation 1: The occurrence of a fire on Gallery 617 A, horizon +30

- ❖ Simulation 2: The occurrence of a fire on the extraction blind shaft between horizons +208 and +188.
- ❖ Simulation 3: The occurrence of a fire on the emergency rising, between horizons +208 and +230.

- I have treated in a unique and original way the issue of the consequences of conscious volitional actions with dangerous gases at the ventilation network of Praid Salt Mine;

- In this regard, I made two simulations for the first time on the updated ventilation network Praid Salt Mine solved with VENTSIM Visual Advanced program, namely:

- ❖ Simulation no. 4 - Dangerous source of toxic gas at the level of Doja fresh air shaft;
- ❖ Simulation no. 5 - Dangerous source of toxic gas at the level Joseph fresh air shaft.