

# **Automated System for Protecting People and Infrastructure from Explosions in Underground Structures**

Mining Institute of Georgia  
7, Mindeli Str., 0186 Tbilisi, Georgia  
www.mining.org.ge  
Tel/Fax: (995 32) 32 95 57  
E-mail: chikhradze@mining.org.ge; mataradze@mining.org.ge

Center for Infrastructure Protection and Physical Security,  
University of Florida, USA  
365 Weil Hall  
PO Box 116580  
Gainesville, FL 32611-6580, USA  
www.cipps.eng.ufl.edu  
Tel: (352) 273-0691; Fax: (352) 273-0186  
E-mail: tedk@ufl.edu

## **Function of the System:**

Quickly reduce the effect of terrorist and non-authorized explosions in underground infrastructure.

## **The presented protecting system can be effectively applied in:**

- motorway and railway tunnels;
- subway tunnels;
- coal mines under threat of methane explosion;
- land- or sea-based oil platforms;
- other petro-chemical plants;
- long superstructures with limited cross sections that could be loaded by gas or dust explosions.

## **System Structure**

The proposed protective system is composed of:

- i) a device for the detection of explosions and activation of an absorber;
- ii) an absorber, which contains a water container with nozzles for dispersed water mist formation.

Absorbers will be installed at regular distance from each other along protected underground openings. Depending on the cross section of underground openings, one, two or more absorbers can be installed along the tunnel section. A proposed protective device will be installed in a special niche of a tunnel support to make sure that it does not affect the normal operation of a tunnel.

Preliminary studies aiming at the selection of the structure and properties of a protective system were conducted within the framework of NATO Science for Peace Programme,

### **The system components**

#### **1. Wireless Device for the Detection of Explosions and Absorber Activation**

The proposed detection device will analyze the fluctuation of pressure in real time. When reaching the threshold pressure, the system will generate and transmit a start signal for absorber activation.

The wireless device consists of a detector block with a transmitter and an absorber control block with a receiver. A detector block contains sensors, a microprocessor equipped with blast/fire detection software and a transceiver, which serves to transmit an encoded signal at 868.35 MHz frequency. The absorber control block has a transceiver that receives the signal at the same frequency of 868.35 MHz, a microprocessor, and a fail safe decoder that produces the activation signal for the operation of a blast absorber.

The transmitter and receiver modules have two modes of operation: on-line and test. When in an on-line mode of operation, both the transmitter and the receiver are prepared to react to the blast. The test mode of operation serves to control the working capacity of the transmitter and receiver blocks.

#### **2. Absorber Activation and Water Discharging Mechanism**

The proposed absorbers consist of a control block, pyrotechnic device for water discharge and a water container with nozzles for dispersed water mist formation. A pyrotechnic device is installed in the body of the lid of a container. It contains cartridge, in which gas generating powder and an electrical initiator are located. An Initiator is connected to a control block.

At the command of the initiation signal, an absorber will be able to produce tailored dispersing water protector barriers along the whole cross section of the tunnel.

Two kinds of containers with integrated spray nozzles have been produced: i) for horizontal dispersal (volume: 220 liters, number of nozzles - 52 nozzles); ii) for vertical dispersal (volume: 96 liters; number 36 nozzles).

The proposed absorber design allows to regulate the pressure in the hydro-system as well as to change the type and number of nozzles, which enables to vary flow rates, water discharge velocity and droplet size.

### **System Properties**

The new protective system at the command of the initiation signal produces tailored dispersing water mist with droplet sizes in the range of 25-400 micron along selected sections of a tunnel and has the following properties:

- the time of absorber activation from the moment of blast - 11 ms;
- speed of a damping agent discharge from an absorber - 60-80 m/s;

- reduction of shock wave overpressures by means of an absorber – at least 1,9-2,7 times;
- the distance between a transmitter and a receiver in a direct tunnel - at least 150m; in a tunnel with a 90<sup>0</sup> bending - 50m;
- minimum overpressure of signal generation - 12 kPa;

**Video:** [www.vimeo.com/19792318](http://www.vimeo.com/19792318)

[www.mining.org.ge/Projects/SFP980981.htm](http://www.mining.org.ge/Projects/SFP980981.htm)



Photos of modules of wireless system for the detection of explosions and activation of an absorber. TX – Transmitter module, RX1– Receiver module.

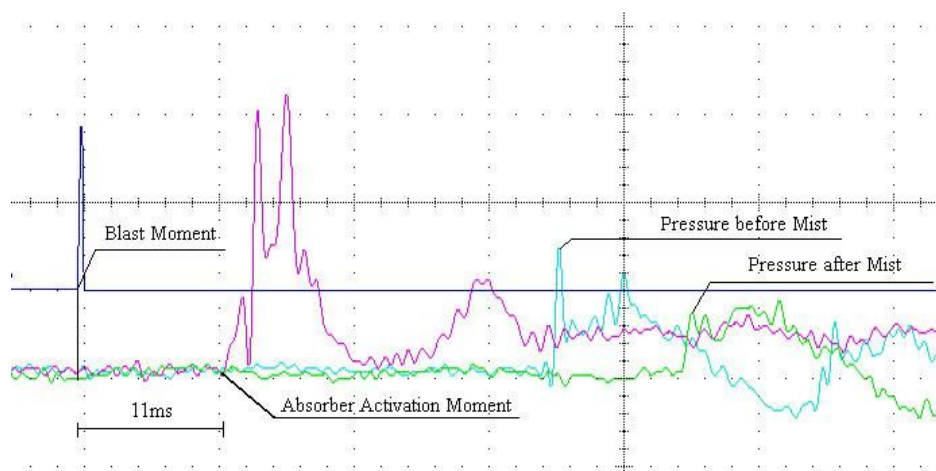


Test samples of an absorber. A – for horizontal dispersal, B – for vertical dispersal.

1 - absorber control block, 2 - pyrotechnic device, 3 - water container, 4 – nozzles



The process of water discharge from the absorber 1 – at the distance of 1,0 m, 2 – 2,0m, 3 - 4,0m, 4 – 12 m.



The characteristic of protective system