ALCOTRA – ALIRHYS PROJECT: CASE HISTORY OF GROUNDWATER QUALITY PROTECTION

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Introduction

The doubling of the Tenda road tunnel that connects SW France to Piedmont (Italy) was planned to penetrate a complicated rock structure with several hydrogeological features including a carbonate-karst aquifer between flysch impervious complexes. The main problem of the project is the presence of a water flow that feeds into a spring at great local economic importance, that discharges into a railroad tunnel below. Therefore, if cement were used for tunnel consolidation it could alter the chemistry of the spring, making it unfit for human consumption.

The aim of the work, performed by a research group of DIATI (Dipartimento di Ingegneria dell’Ambiente, del Territorio e delle Infrastrutture), was to identify the best indicators of the presence of such cement in water.

Methods and results

Fig. 1 shows the geological section of the Tenda pass. The aquifer is intercepted in the zone where the contact (permeability threshold) is situated, between the upper limestone formation and the upper flysch formation (Banzato et al. 2011). The area feeding the spring is a narrow, straight NW-SE band, which goes from the deep Cabanaira valley to the Val Grande di Palanfrè.

![Geological section of the current road tunnel with positions of the main water flows.](image)
Using monitoring data the pollution vulnerability of the springs, according to the VESPA method (Galleani et al. 2011), turned out to be low. The vulnerability assessment was performed related to the spring recharge area without the preferential drainage route that the tunnel represents. The concentration of any cements in the water would not be attenuated because the terrain “filter effect” would be less significant. On this basis, in order to configure a possible alarm system, efficient indicators of the presence of cement in water should be identified.

Some tests were performed, in the laboratory, on the basis of following parameters:
- Turbidity
- pH
- Electrical Conductivity (EC)

Tests have shown that the EC is not a good indicator of the presence of cement in water, in fact by increasing the cement concentration in water, this parameter decreases first and then resumes the upward trend. However, tests on turbidity and pH have given interesting results. As expected, the turbidity, by increasing the cement concentration in water, grows in a rather linear way (Fig. 2);

The pH has also proved to be a valid indicator of the presence of cement in water (Fig. 4).

The results of the tests showed that turbidity (Fig. 2) and pH (Fig. 4) give strong indications of the presence of cement in water: a working solution could be the combined use of these indicators. The use of a double indicator allows errors related to natural variations on a single parameter to be avoided.

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References
