

Reduction of water inflow into tunnels, using ultrafine cement

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Kumagai Gumi Co., Ltd. has developed an innovative inflow blocking system for tunneling. Featuring a post-grouting method, the blocking system forms a ring of improved water-tight ground 3 meters thick on the whole sectional circumference, from inside the tunnel (Fig. 1).

Conventionally, slag cement (10 μm in average diameter) and superfine particle cement (4 μm in average diameter) have been used. Since it is difficult achieving a target permeability of 4×10^{-6} cm/sec in ground with these materials, we determined to use new ultrafine particle cement (1.5 μm in average diameter) which is excellent in permeability.

During boring the Hokusatsu Tunnel, a huge water inflow containing a high level of arsenic occurred.

In particular, a 100-meter section, extending from 1,800 meters to 1,900 meters from the portal, was situated in a zone with low boring rate where there were many cracks in the boundary of the granite and a layer of alternating sandstone/shale. This section also was highly prone to water inrush of approximately 300 tons/hour, with a total arsenic amount of 0.16 mg/L (Photo 1).

For the project, we were required to provide a permanent measure for blocking arsenic water inflow.

Thanks to the blocking measure which was provided for the section of 100 meters, the water inflow was reduced from a maximum of 300 tons per hour to less than 40 tons per hour.

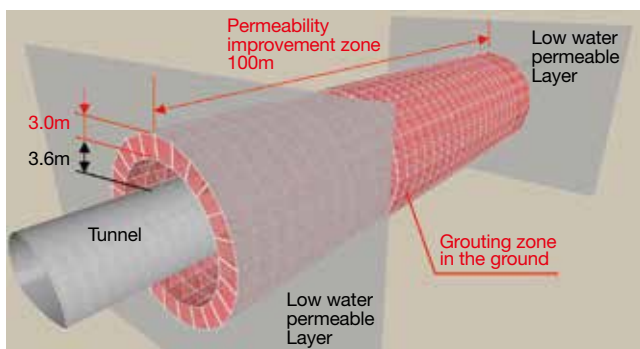


Fig. 1 Diagram of ground improvement zone



Photo 1 Water gush during tunnel excavation