

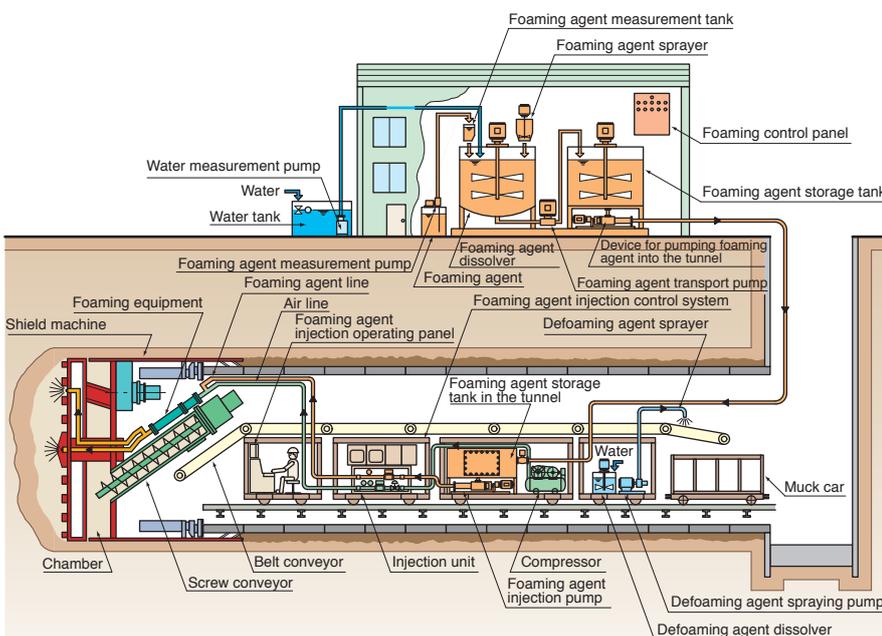
# Rheological Foam Shield Tunneling Method

Rheological foams control all types of soil

## Characteristics

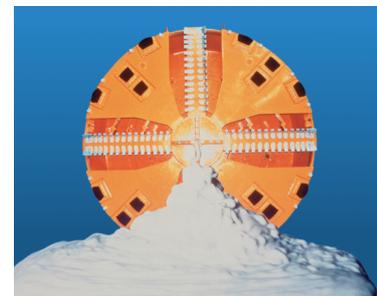
- Increased fluidity of excavated soil**  
 In gravel layer, rheological foams work as ball bearings and increase the fluidity of excavated soil.
- Reduction of fluctuations in face pressure**  
 The compressive character of rheological foams can reduce fluctuations in face pressure.
- Higher watertightness of excavated soil**  
 The groundwater in void space between soil particles of excavated soil is replaced by tiny foams, so the excavated soil can have higher watertightness.
- Effectiveness in preventing adhesion of excavated soil**  
 In hard, cohesive bedding, adhesion of excavated soil on the shield face plate and inside the chamber is prevented.
- Easy treatment and disposal of excavated soil**  
 Excavated soil is restored to the original state when it was in the ground and therefore can be treated or disposed of easily.
- Improvement of working environment**  
 Neither clay nor bentonite is used, so the tunnel is clean and offers a better working environment.
- Downsizing of equipment**  
 Only small equipment is required for generating and injecting foams.

## Outline of tunneling equipment



## Mechanism of tunnel driving

The Rheological Foam Shield Tunneling Method excavates a tunnel while injecting foams into the face and the chamber. Foams are generated with special foaming agent. Injected tiny foams with properties similar to those of shaving cream can improve the fluidity and the watertightness of excavated soil. Foams can also prevent the soil from sticking inside of the chamber. This enables smooth tunnel driving while keeping face stability. In addition, the removed soil with foams can be defoamed and put back the state before foam injection. Then excavated soil can be easily transported and disposed of. Thus, the method also has economic merit.



## Applications to actual tunneling

### [Large-section shield tunneling]



▲ Construction of underground section of Hanshin Electric Highway line near Fukushima (Diameter: 10.8m, length: 210m)

### [Long-distance, small-radius-curve shield tunneling]



▲ Improvement of the Higashi-kibogaoka storm sewer in the Midori treatment district (Diameter: 6.15m, length: 2,050m, radius: 20m)