

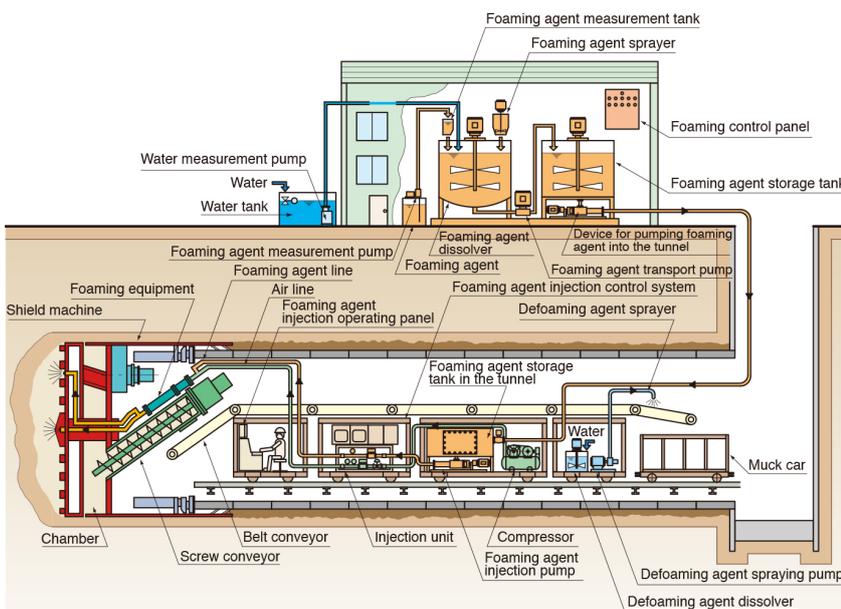
# Rheological Foam Shield Tunneling Method

All soil types can be handled using rheological foams

## Characteristics

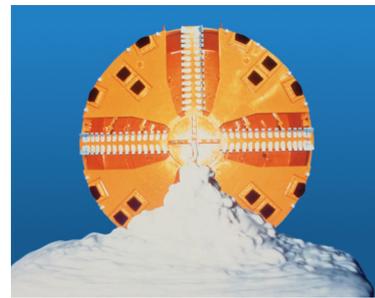
- Increased fluidity of excavated soil**  
 In the gravel layer, rheological foams work as ball bearings and increase the fluidity of excavated soil.
- Reduction of fluctuations in face pressure**  
 The compressive character of rheological foams can reduce fluctuations in face pressure.
- Higher watertightness 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 the case of hard cohesive soil, 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, transportation and disposal of excavated soil is handled easily.
- Improvement of working environment**  
 As clay or bentonite is not used, the tunnel remains clean, and the working environment is improved.
- Downsizing of equipment**  
 Only small equipment is required for creating and injecting foams.

## Outline of tunneling equipment



## Mechanism of tunnel driving

Using the Rheological Foam Shield Tunneling Method, the tunnel is excavated while injecting foam into the face and the chamber. Foams are generated with a special foaming agent. Injected tiny foams with properties like those of shaving cream can improve the fluidity and the watertightness of excavated soil. Foams can also prevent the soil from sticking inside the chamber. This enables smooth tunnel driving while keeping face stability. In addition, the removed soil with foam can be defoamed and put back in the state before foam injection. Therefore, transportation and disposal of excavated soil is handled easily, making it a highly economical method.



## Applications to actual tunneling

【Large-section, Long-distance shield tunneling】



Metropolitan Expressway, Central Circular Route  
Shinagawa Line  
(Diameter: 12.55m, Length: 8,030m)

【Large-section, Long-distance shield tunneling】



Yokohama Circular Northern Route shield tunnel project  
(Diameter: 12.49m Length: 5,507m , Two lines)