



**泡沫  
気泡**     ***Grout Devices***  
***Foaming***

***CIVIL ENGINEERING, SHIELD  
BACKFILL GROUTING***

***TAC CORPORATION***

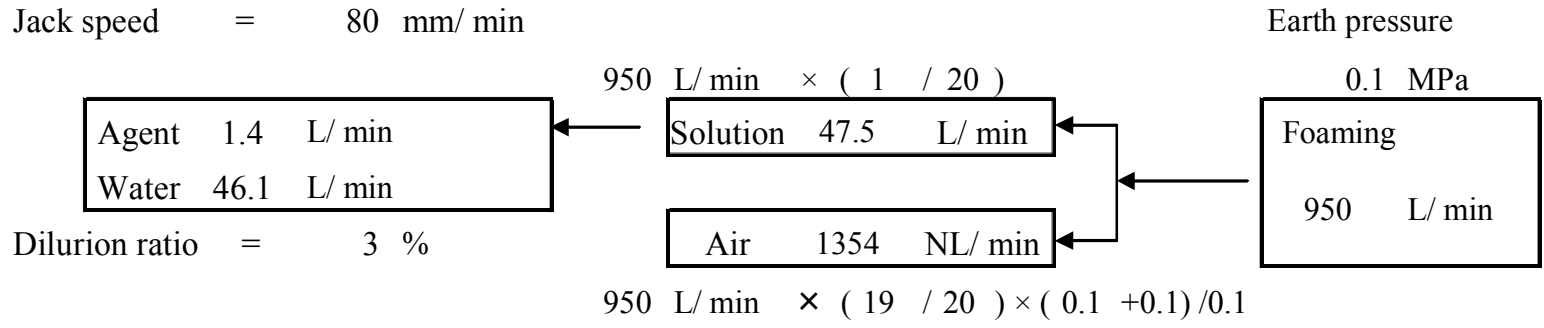
# 1. Calculation Sample of Foaming

1 .	Conditions								
1	TBM O.D						6.15	m	
2	Excavation D						6.15	m	
3	Segment O.D						6.00	m	
4	Segment width						1.20	m/ 1R	
5	TBM speed						80	mm/ min	
6	Earth pressure	≡ Internal chamber pressure						0.05	MPa
7	Foaming injection ratio						40.0	%	
8	Concentration	(Agent) / (Solution)						3	%
9	Expantion ratio	(Foaming) / (Solution)						10 ~ 20	times
10	TBM cross-sectional area	$\pi / 4 \times$	$6.15^2$				29.71	m <sup>2</sup>	
11	Foaming injection volume / 1m	29.71	m <sup>2</sup> × 1m	×	0.40		11.88	m <sup>3</sup>	
12	Air injection volume / 1m at 1/20	11.88	m <sup>3</sup> / 1m	×	( 19 / 20 ) × ( 0.1 +0.1 ) /0.1		16.93	Nm <sup>3</sup>	
13	Air injection volume / 1m at 1/10	11.88	m <sup>3</sup> / 1m	×	( 9 / 10 ) × ( 0.1 +0.1 ) /0.1		16.04	Nm <sup>3</sup>	
14	Solution volume / 1m at 1/20	11.88	m <sup>3</sup> / 1m	×	( 1 / 20 )		594	L	
15	Solution volume / 1m at 1/10	11.88	m <sup>3</sup> / 1m	×	( 1 / 10 )		1188	L	
16	Foaming injection volume / 1R	11.88	m <sup>3</sup> / 1m	×	1.20 m/ 1R		14.26	m <sup>3</sup>	
17	Air injection volume / 1R at 1/20	16.93	Nm <sup>3</sup> /1m	×	1.20 m/ 1R		20.32	Nm <sup>3</sup>	
18	Air injection volume / 1R at 1/10	16.04	Nm <sup>3</sup> /1m	×	1.20 m/ 1R		19.25	Nm <sup>3</sup>	
19	Solution volume / 1R at 1/20	594	L/ 1m	×	1.20 m/ 1R		713	L	
20	Solution volume / 1R at 1/10	1188	L/ 1m	×	1.20 m/ 1R		1426	L	
21	Agent volume / 1R at 1/12	713	L/ 1R	×	3 %		21	L	
22	Agent volume / 1R at 1/8	1426	L/ 1R	×	3 %		43	L	
23	Foaming injection flow	11.88	m <sup>3</sup> / 1m	×	0.08 m/ min		950	L/ min	
24	Air injection flow at 1/20	16.93	Nm <sup>3</sup> /1m	×	0.08 m/ min		1354	NL/ min	
25	Air injection flow at 1/10	16.04	Nm <sup>3</sup> /1m	×	0.08 m/ min		1283	NL/ min	
26	Solution injection flow at 1/20	594	L/ 1m	×	0.08 m/ min		47.5	L/ min	
27	Solution injection flow at 1/10	1188	L/ 1m	×	0.08 m/ min		95.0	L/ min	

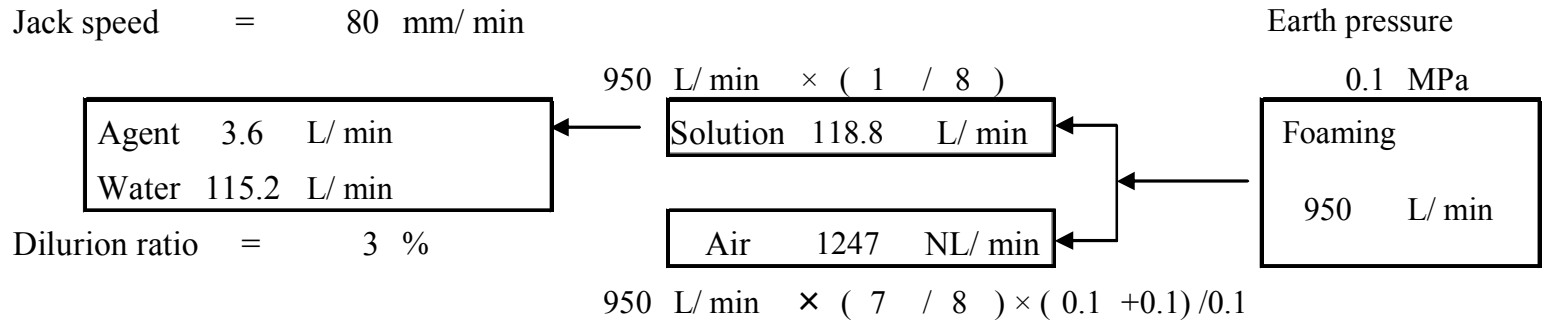
# 2. Models of Foaming

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Expansion ratio = 20 times  
 Jack speed = 80 mm/min



Expansion ratio = 8 times  
 Jack speed = 80 mm/min

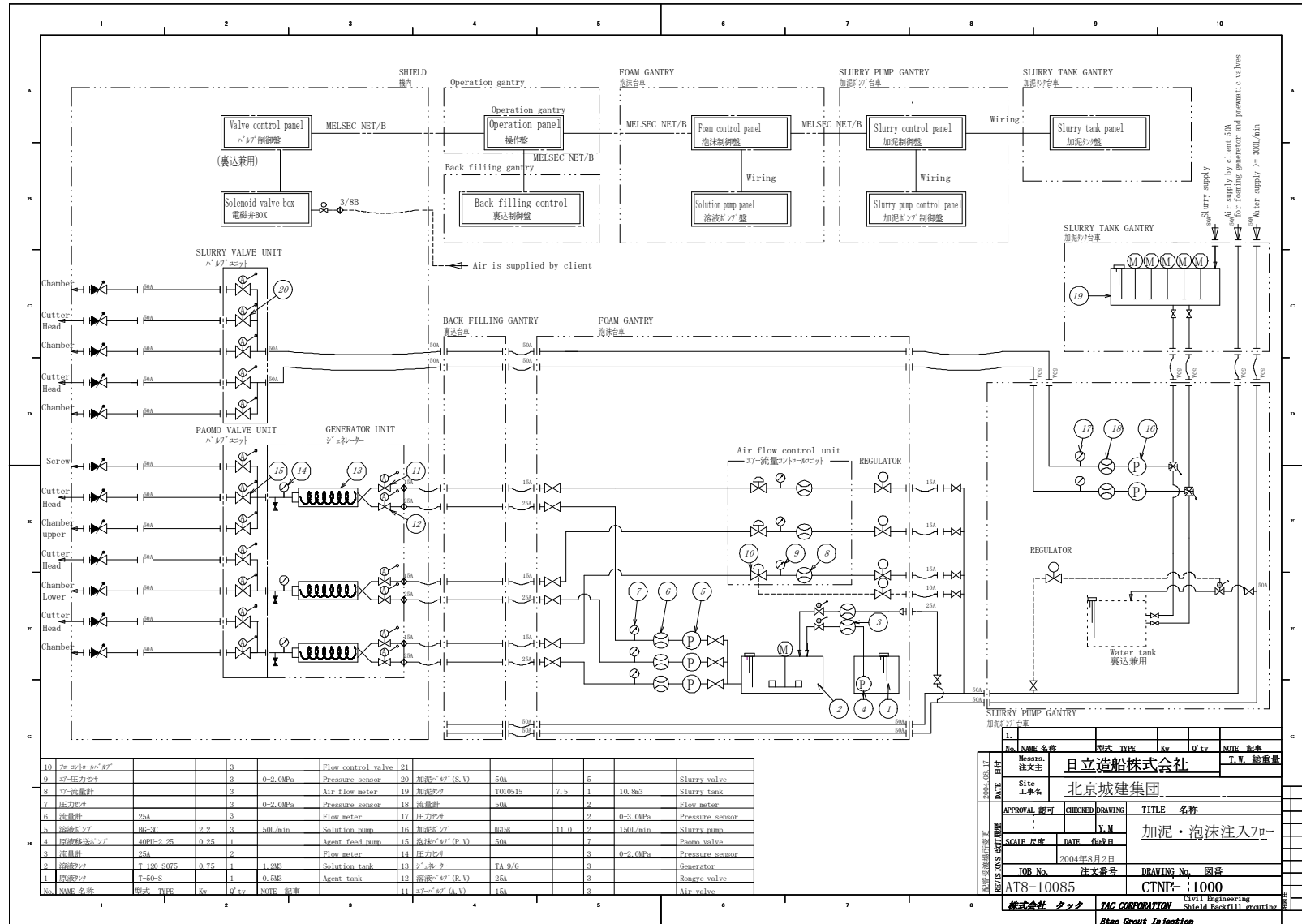


# 3. Specifications of Devices

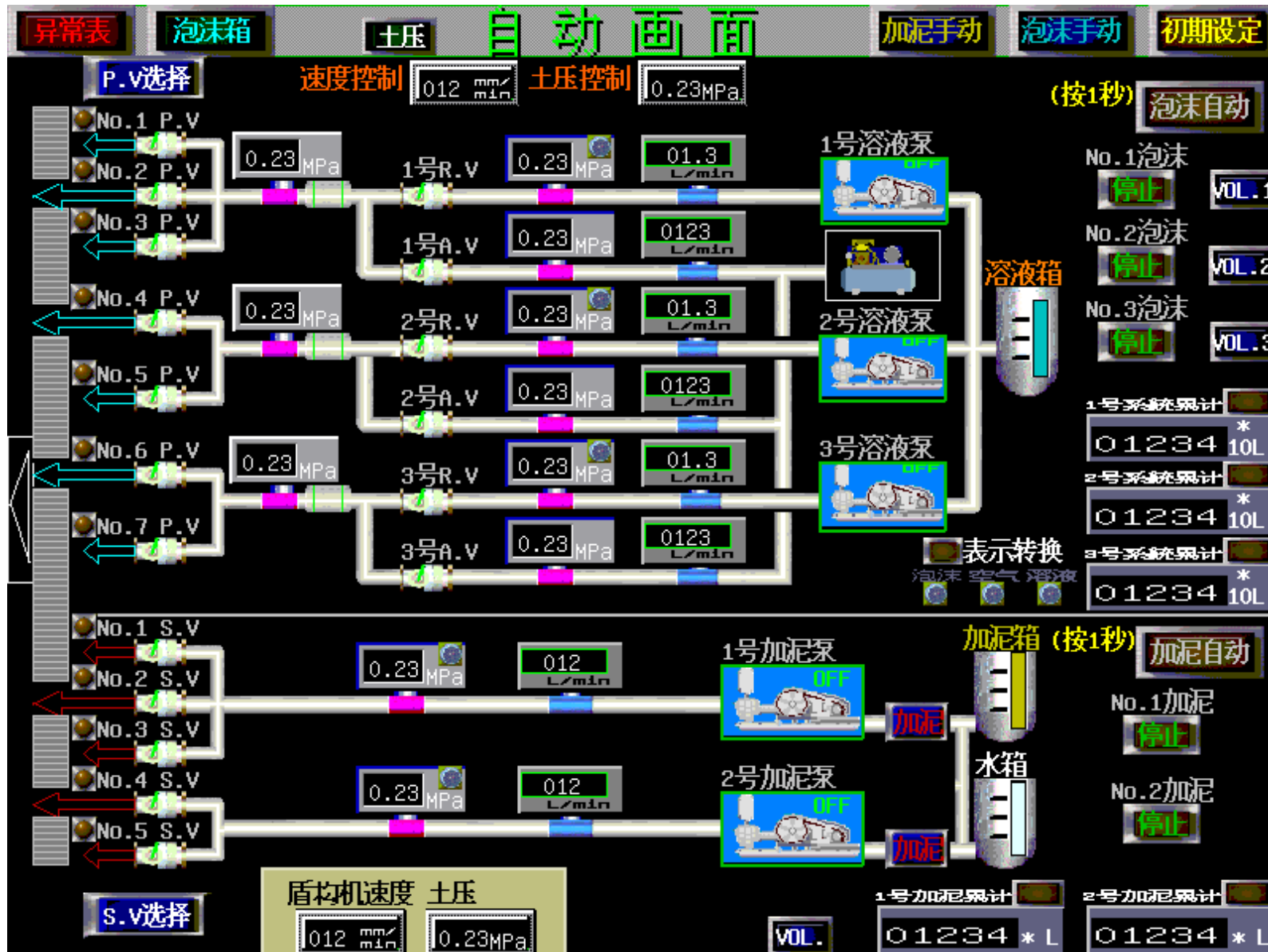
## 3. Specifications of devices

1	Foaming agent tank	0.6m <sup>3</sup>	≥ 0.053 m <sup>3</sup> /1R×4
2	Foaming solution tank	1.25m <sup>3</sup> + Automatic mixing system	≥ 1.78 m <sup>3</sup> / 1R
3	Foaming agent feed pump	0.25kw	
4	Water feed pump		
5	Foaming pump	Tube type 2.2kw Max1.2MPa 25L/min×3nos.	≥ 118.8 L/min
6	Compressor	equivalent 22kw Max1.00MPa 3.2m <sup>3</sup> /min×efficiency0.65 × 1no.=2.08Nm <sup>3</sup> /min	Client ≥ 1.35 Nm <sup>3</sup> / min
7	Flow control valve	3nos.	
8	Air flow meter	3nos.	
9	Flow meter for measure	3nos.	
10	Pressure sensor	Air=3nos. Sol.=3nos. Foaming=3nos.	
11	Generator	3nos.	
12	Foaming control panel		
13	Foaming pump control panel		
14	Valve control panel		
15	Operation panel		

# 4. Foaming Flow



# ·Foaming Flow (Operation Panel)



# 5. Foaming Devices

Variety of foaming liquid Pumps

Tube Type



Screw Type



Piston Type



Turbine Type

This type is usually used in Europe.

For separate grout method.

# ▪ Foaming Devices

## Air Flow Control



## Foam Generator



## Foam Test



## Mixing Test (Foam+soil)



## 6. Control Panel (Parameter Screen)

异常表 泡沫箱 初期设定画面 自动 加泥手动 泡沫手动

**泡沫设备**

盾构机挖掘面积  UP DOWN

土压的值

泡沫倍率设定  UP DOWN

溶液搅拌机 下限停止解除

压力控制

泵速度控制

千斤顶速度控制

注入停止方法

固定压力设定  UP DOWN

注入率设定  UP DOWN

固定速度设定  UP DOWN

溶液泵停止的压力上限值设定

No.1溶液泵  UP DOWN

No.2溶液泵  UP DOWN

No.3溶液泵  UP DOWN

**加泥设备**

加泥搅拌机

No.1 No.2 No.3 No.4 No.5

下限停止解除

泵速度控制

注入率设定  UP DOWN

注入停止方法

加泥泵停止的压力上限值设定

No.1加泥泵  UP DOWN

No.2加泥泵  UP DOWN

# 7. Foam Agent Plant

This system is batch one.

This one is for both Foam and Polymer.

