



- **SLURRY TREATMENT PLANTS  
FOR MIXED SHIELD TUNNEL  
BORING MACHINES**
- **SEEPAGE WATER TREATMENT  
PLANTS**



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# References in Underground Works

*M.S first started its activity in the field of sand processing and concrete aggregates preparation, in quarries, gravel and sand pits, then went on to develop techniques and equipment for waste water recycling, and lastly to include the final process equipment required in this field : sludge presses.*

*In more twenty five years, our company has accumulated enough know-how and experience to be recognized as a leader in France, in two specific markets : firstly sand-processing, water recycling and sludge pressing in quarries and sand pits, and secondly desanding equipment for bentonite slurry.*

*In fact this industrial field, like other special foundation works, demands the same expertise in processing excavated products, transported in the form of slurry, as well as a perfect control of the bentonite slurry regulation and treatment of excess clay. In addition this has to be achieved, most of the time in a small available space, while taking into account the urban environment restrictions.*

**The Slurry Treatment Plants for Slurry Shield Tunnel Boring Machine have to conform to more and more stringent specifications :**

- from the geological point of view, the diversity and instability of terrains demands an exceptionally flexible design, which in particular must enable rapid modifications of the rheological characteristics of the slurry in terms of its density and viscosity.
- from an ecological point of view, it is important to treat all the water and sludge produced. It must be entirely transformed into solid form to facilitate disposal and reduce transport cost.

On sites such as **Lefortovo Tunnels** or the **Groene Hart** project, MS has risen to this challenge by successfully developing complete **Slurry Treatment Plants** which are in operation since the end of 2001.



*Météor STP (Paris)*



*Sydney STP during erection*



*Cairo STP*



*Sophia STP during erection*

These plants comprise 4 sections :

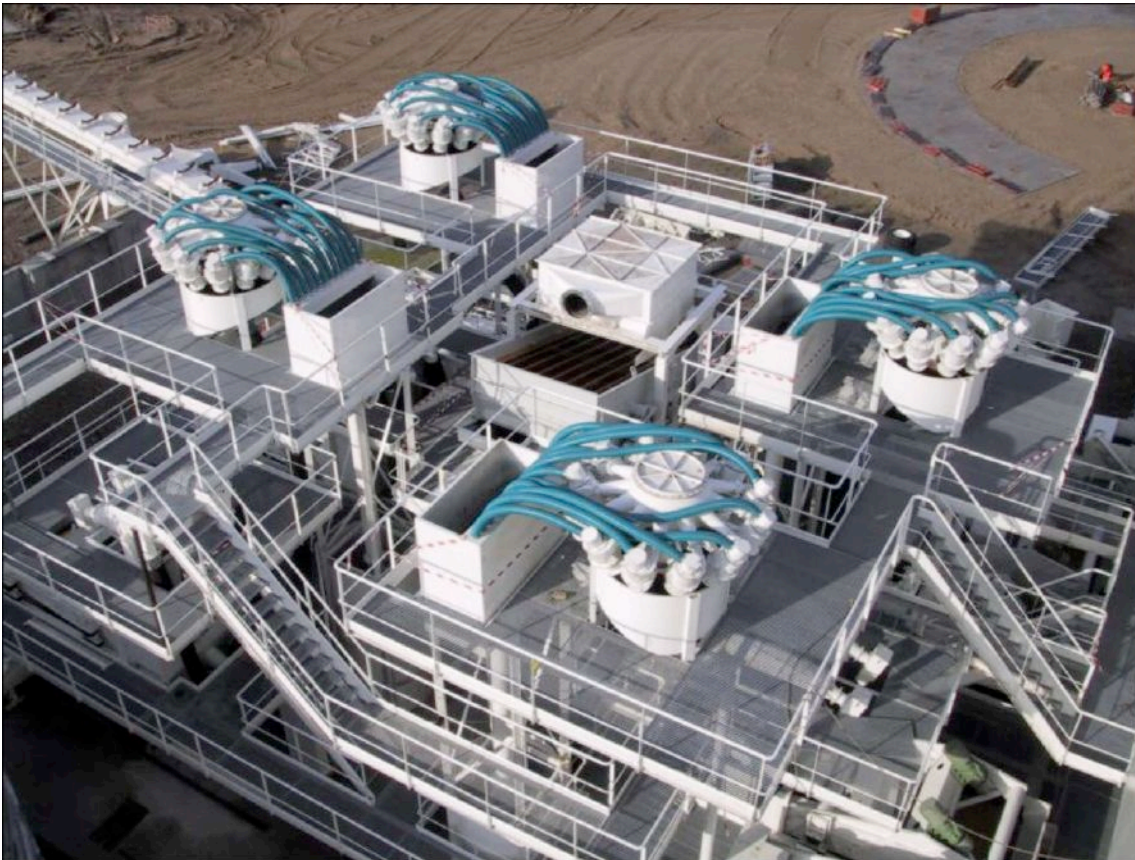
- **scalping/desanding/ dessilting**
- **recycled mud management**
- **excess mud management,**
- **surface and drainage waters management.**

Our originality lies in having developed equipment and techniques specific to each of these 4 sections :

- in the **scalping section**, trommels are superior to vibrating screens to avoid clogging with sticky clay, while maintaining a lower dilution of these clay and therefore a better control of the quality of the sludge.
- in the **desanding-desilting section**, MS propose complete plants with one, two or three stages of high-performances cyclones depending on the geological type of bored soils. MS supplies plants composed of monobloc modular units. Sands are dewatered in order to obtain a minimal residual water content.



*MS designs and manufactures dewaterers equipped with polyurethane deck and unbalanced motors giving an acceleration of 5 to 6 g*



*Groene Hart*  
*2500 m<sup>3</sup>/h*  
*(during erection)*



*Pannerdensch  
Kanaal*  
*1600 m<sup>3</sup>/h*  
*(during erection)*



*Toulouse  
section n°4  
1 200 m<sup>3</sup>/h*



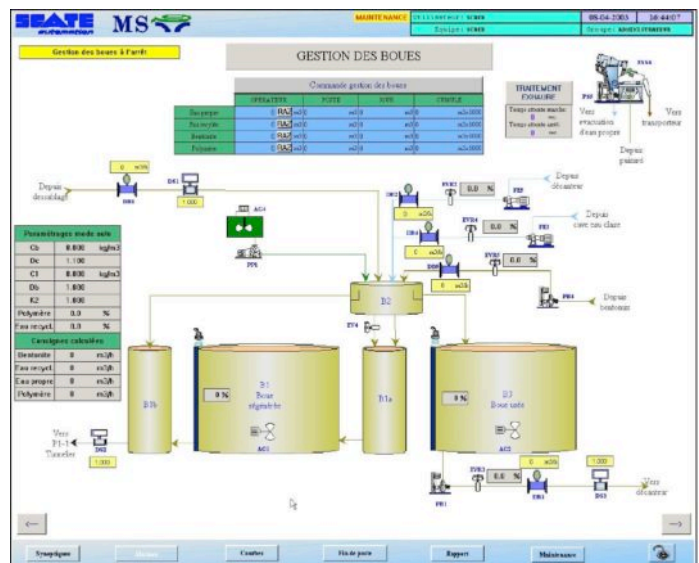
*Lefortovo  
(Moscow)  
2800 m<sup>3</sup>/h  
(during erection)*

□ as far as the **Sludge Management Section** is concerned, MS has developed and patented a monitoring system, designed to assure 4 essential functions :

- **maintaining the balance of the sludge volume**, *i.e. compensate any losses in the ground or anywhere else*,
- **maintaining the balance of the solids**, *i.e. mainly eliminate or compensate any addition of excavated materials in order to keep the desired density of the conveying slurry*,
- **maintaining and adjusting the rheologic characteristics of the conveying slurry**, *according to the choice made by the operator thanks to the information given by the rheometer (viscosities, densities & Yield value)*,
- **direct addition to P1** of a fresh specific mud for any particular need, for example to prepare one hyperbaric maintenance operation.



Main bentonite preparator « Bentomix »



Supervision view : Mud management (MS patent)

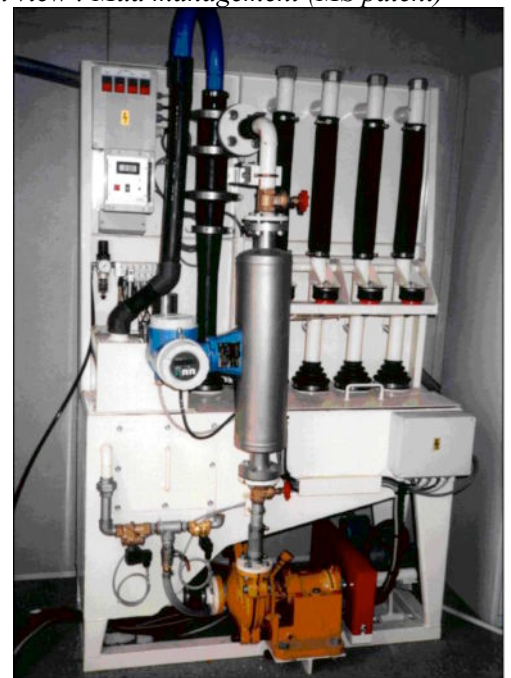
The MS rheometer is fed by 4 samples of sludge :

- desanded sludge from B<sub>2</sub>
- regenerated sludge from B<sub>1</sub>
- sludge returning to TBM, taken from B<sub>1-b</sub>
- sludge coming from TBM, taken from B<sub>3</sub>.

Each sample is taken alternatively in a pumping tank fitted with one centrifugal pump feeding one protection cyclone and one automatic measuring system, analyzing :

- 1° ) the density,
- 2° ) the plastic & apparent viscosity,
- 3° ) the “Yield Value”

These data are stored by the PLC and displayed as graphs by the supervision screen. Depending on the evolution of these values, the operator choose the addition of fresh bentonite, of polymer or water in order to maintain the desired rheologic properties of the slurry. In automatic mode, this system allows to keep constant the set value.



MS Rheometer

- in the clay management section, MS has developed its own range of filter-presses specially adapted to this kind of application.



*Pressing section with Filer-Presses FP 12-D12-M - Sydney*



*Cakes after pressing*



*Filter-Press FP 15-C75-M « Compact » type with pneumatic cakes release*



# References in Underground Works

- in **surface and seepage waters management section**, MS has acquired a significant experience in this field with references such as VL10, NCSM, Météor MO2, Hong-Kong (KCR320 / Lok Ma Chau) or Lötschberg plants.

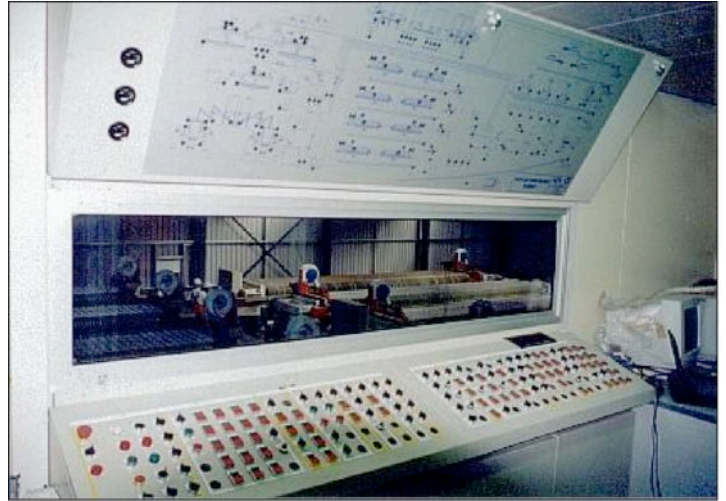


*Seepage water  
treatment plant  
(Groene Hart)  
200 m<sup>3</sup>/h*

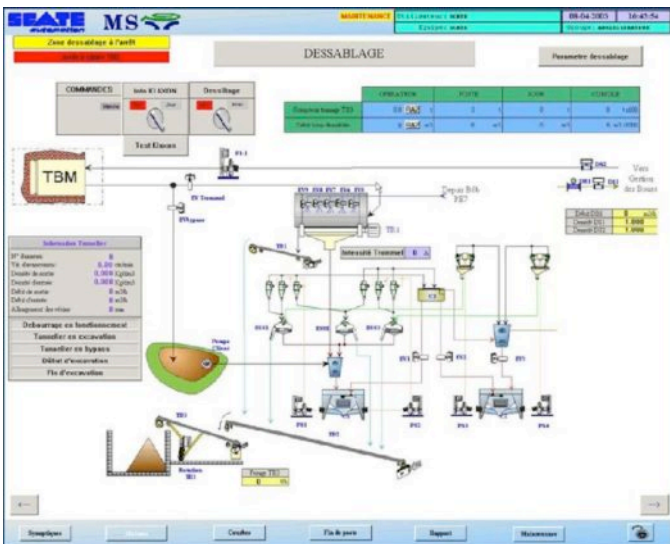


*General view  
of IGCN plant  
with specific  
seepage water  
treatment*

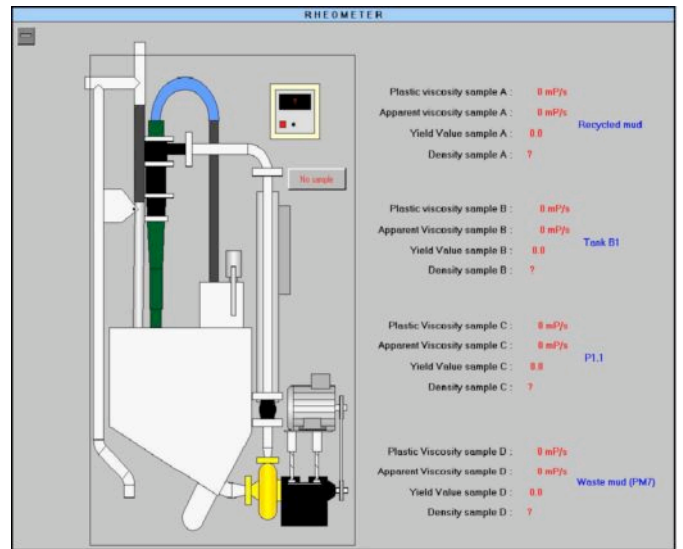
- These sections are monitored by a sophisticated automaton, with visualization and control on screen of each section.



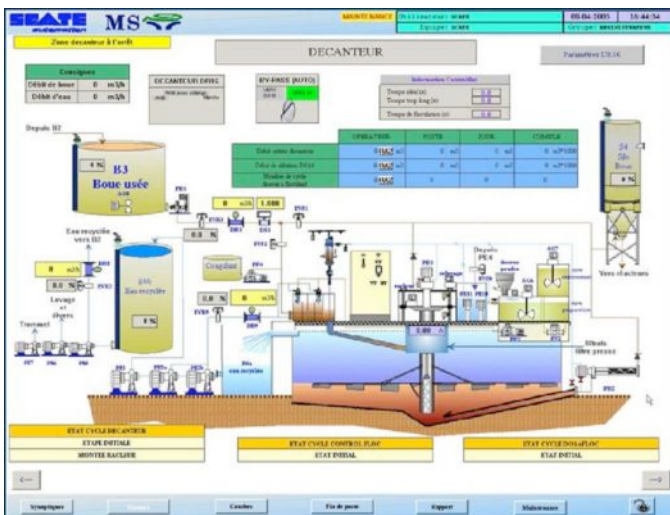
### Supervision views :



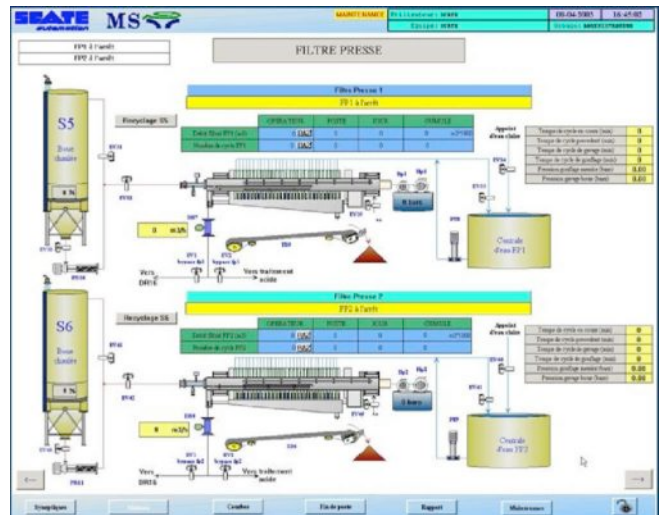
Desanding section



Control of rheologic characteristics



Flocculation - Thickening



Pressing section



# References in Underground Works

Name and Place	Year	Customer	Type of tunnel	Supplier of the TBM	Bored Ø (meters)	Total Length (meters)	Geological Composition of Terrains	Brief Description of the plant	Feed Pulp m <sup>3</sup> /h
Hallandsås Båstad - Sweden	2005	Skanska / Vinci	Railway Tunnel	Herrenknecht	10,60	2 x 5,500	Gneiss	STP with water treatment & 2 Filter-presses <i>in progress</i>	1,800
Tunnel Maurice Lemaire	2004	Bouygues / Eiffage	Service Tunnel	Herrenknecht	6 m	6,900	Granite + other rocks	site water treatment plant	150
Silberwald tunnel MOSCOW	2004	Herrenknecht	Highway tunnel	Herrenknecht	14,20	2 x 1,750	Sand + clay	Addition of 6 Filter-Presses + equipment (FP)	2,800 + 2,000 T/day of dry solids
Lok Ma Chau HONG-KONG	2003	D.J.V (Bouygues)	Railway Tunnel	N.F.M.	8,75	-	Granit & alluvial deposit	STP for hyperbaric maintenance with water treatment & 1 Filter-press	150
VL10 Choisy Paris	2002	SADE / EIFFAGE	Sewage Tunnel	Herrenknecht	4,0	2,300 m	Sand + clay	Compact drainage waters treatment plant	60
Soumagne Tunnel Belgium	2001	Vinci / Bouygues / Eiffage / W&Freitag	Railway Tunnel	<i>explosive</i>	11,8	5,940 m	Granite	Compact drainage waters treatment plant + pressing	50
TOULOUSE Line B lot n°4	2002	GIE MT B4	Subway	Herrenknecht	7,82	2 x 3,731 m	Molasses & Graves crues de la Garonne	STP with 2 filter-presses	,200
A86 tunnel PARIS	2001-2002	SOCATOP	Highway tunnel	Herrenknecht	11,56	3,100 m	Fine sands with clay Fontainebleau type	STP with auxil. water treatment & 2 Filter-Presses compact type (FP)	20 T/h of excess dry matter
Lefortovo tunnel MOSCOW	2001	Herrenknecht	Highway tunnel	Herrenknecht	14,20	2 x 2,200	Limestone + clay	STP with auxil. water treatment & 6 Filter-Presses (FP)	2,800
Pannerdensch Kanaal Netherland	2001	COMOL vof	Railway tunnel	Herrenknecht	9,80	2 x 1,425	90% fine sand 10% clay	complete STP with 2 FP	1,600
Groene Hart Netherland	2001	Bouygues KOOP	Highway tunnel	NFM	14,87	7,160	Fine sand	complete STP with 2 FP	2,500
Lötschberg Tunnel Swiss	2001	ARGE FERDEN	Railway Tunnel	Robbins/Atlas Copco	5,03	34,600 m	Granite	Drainage waters treatment plant	200
KCR 320 HONG-KONG	2000	D.Z.J.V (Bouygues)	Railway Tunnel	N.F.M.	8,75	2 x 1,840	Granit & alluvial deposit	STP for hyperbaric maintenance with water treatment & FP	120



# References in Underground Works

Name and Place	Year	Customer	Type of tunnel	Supplier of the TBM	Bored Ø (meters)	Total Length (meters)	Geological Composition of Terrains	Brief Description of the plant	Feed Pulp m <sup>3</sup> /h
<b>Sophia Netherland</b>	2000	TUBECON	Railway Tunnel	Herrenknecht	9,82	2 x 4,200	Pleistocene & Holocene sand	complete STP with 2 FP	2,500
<b>Ru de Marivel SIAVRM</b>	1999	Campenon Bernard Dumez	Sewage Tunnel	Herrenknecht	5,14	1,330	Chalk sand & gravel	complete STP with 1 FP	900
<b>I.G.C.N. Gennevilliers</b>	1998	Borie SAE GTM Constr. Chantiers Mod. Chagnaud	Sewage Tunnel	Herrenknecht	4,85	1,288 + 2,047	Marl, limestone & sand from Soissonais	STP with auxil. water treatment & 2 FP	600
<b>B.P.N.L. Lyon</b>	1997	Bouygues Dumez GTM	Road Tunnel	N.F.M.	11	3,200	Alluvial deposit	STP for hyperbaric maintenance	300 to 500
<b>LEWISHAM Londres</b>	1997	Nishimatsu Kawasaki F.C.B.	Subway	Kawasaki	5,90	2 x 1,044	Gravel, sand, clay & silt	complete STP, with 1 FP	600
<b>Airport Link SYDNEY</b>	1997	Transfield Bouygues Joint Venture	Subway	Herrenknecht	10,80	5,475	Marl, sandstone, shale fine to medium, clay & sand, clay	complete STP with. water treatment & 10 FP	2,000
<b>CAIRO SUBWAY</b>	1994 1995	Campenon B. Bouygues Dumez Arab c Fougerolles Spie Batign.	Subway	Herrenknecht	9,45	Cairo 1 : 3,229 Cairo 2 : 2,703	Fine sand, fairly clear	STP without FP	1,500
<b>Line F LILLE</b>	1994 1995	Soletanche Bouygues	Subway-Val	FCB	7,85	2,131	Hard clay, tufa & sand silt	STP without FP	1,000
<b>METEOR Paris</b>	1993 1994	Bouygues Dumez Chantiers Mod Perforex	Subway	HDW	8,65	4,293	Coarse-grained limestone, marl & rocks	complete STP, with 3 FP	1,200
<b>CLICHY la BRICHE</b>	1993 1994	Bouygues GTM BTP Chantiers Mod.	Sewage Tunnel	Herrenknecht	4,07	2,334	Fine sand, marl, coarse-grained limestone	complete STP, with 2 FP	450
<b>Strasbourg (*)</b>	1993	Kesser	Tramway	Herrenknecht	8,20	1,200	Clean alluvial deposit	STP without FP	900
<b>TOULOUSE (*)</b>	1990	GTM	Subway-Val	FCB	7,70	almost 3,500	Sand clay & molasse	STP without FP	500
<b>SEVRES ACHÈRES (*)</b>	1989	GTM BTP Bouygues Chantiers Mod.	Sewage Tunnel	Herrenknecht	4,00	3,500	Clay, fine sand, marl & limestone	STP without FP	450

N.B. (\*) the first three references concern contracts taken under the name of FOREM, but with MS design.