Introduction to Slurry Treatment System
Company profile

The Safecleen Engineering Machinery Co., Ltd (Originated from Black Whirlwind Engineering Machinery Development Co., Ltd) is wholly owned subsidiary of China Metallurgical Geology Bureau. The Safecleen owns 60 years historical evolution.

It’s a National high-tech enterprises. The Safecleen is Hubei province technology center of slurry treatment, Provincial Enterprise Technology Center. The Safecleen is professional manufacturing enterprise for foundation construction equipment, such as slurry treatment, urban pipeline sludge disposal, river dredging, lake desilting, atmospheric dust, grouting, etc.

It’s a pride that Safecleen owns independent brands and technology patents in engineering slurry treatment. After 20 years of continuous innovation and accumulation, the technology of slurry treatment has reached the international advanced level. Completed the slurry shield supporting more than 30 lines. Safecleen becomes a “slurry treatment expert” enterprise which is the greatest, the most mature and owns the most high market share in China. What's more, its products are exported to all over the world, and it makes successful application in a number of key projects both at home and abroad.

The general manager Zhang Pei Qiang with all staff in Safecleen warmly welcome domestic and foreign customers to visit Safecleen, and would like to establish sincere cooperation with them.
Company profile
Function of slurry treatment system:

1. Provide closed cabin of excavation face with good-quality bentonite slurry required by TBM.

2. Enable the density and viscosity of slurry to satisfy the requirement like forming of mudpack of high permeable sand layer and stability of excavation surface.

3. Deliver the mixed slurry formed from cutting of soil, sand and stone transport to the ground for separation and treatment then recycle the slurry for reuse.

4. Support and stabilize the soil mass of excavation surface. The tunnel face will support the soil mass effectively by the slurry balance between slurry pressure and front earth pressure.

5. Cool and lubricate the cutter head and cutting wheel.

6. Match the grade of slurry particle as per different requirements of osmotic coefficient.
Slurry treatment scheme

- TBM circulation system
- Slurry to be treated
- Hydro-cyclone separation system
  - The slurry after hydro-cyclone
  - Underflow
  - Slag discharge
- Slurry management system
  - Fresh slurry
  - Clear water
  - Waste slurry filter press system
  - Slag discharge
- Fresh slurry preparation system
- After Slurry management
The upgrade and update of slurry treatment system

1代

2代

Integration layout
Optimize selection
Increase the screen width
Dewatering and screening
Improve the unit capacity

2nd stage treatment
Structure of slurry treatment system (1000m³)
Combination of slurry treatment system (2000m³)
Combination of slurry treatment system (550m³)

Min Capacity: 400m³/h
Max Capacity: 650m³/h
Principles of Hydro-cyclone separation

1. Slurry to be treated
2. Prescreen
3. Mud mass and stone
4. 1st storage tank
5. 1st hydro-cyclone
6. Sand
7. Silt
8. Dewatering screen
9. Slag
10. 2nd storage tank
11. 2nd hydro-cyclone
12. to TBM
Filter press treatment

Water content of Filter cake $\leq 25\%$

Filtrate solid concentration $\leq 2\text{g}/\text{L}$
Site layout

Way of layout of slurry pool

Slurry treatment plant
Filter press
Control room
Access of excavator
vertical shaft
Slurry storage pool
Slurry preparation unit
For piping
pump pit
control area
water pool
Adjustment area for slurry to be pressed
sedimentation tank
Slurry management
Slurry-recycling tank
Site layout

Way of Layout of Slurry Tank
1. Set up negative angle pre-screening on large area and screen quickly the mud mass and stone.

2. Set up 2nd stage treatment of cyclone and dewatering screening system to eliminate harm solid phase from slurry.
3. Set up slurry preparation and management system with large capacity to cope with the total capacity and slurry parameter change.

4. Set up 3rd stage treatment system to cope with large quantity of wasted slurry and deserted slurry.
Selection of key components and parts:
Cyclone: KREBS/AKW
Slurry pump: Yangzi River
Screen plate: POLYDECK
Vibration motor: OLI
PLC: SIMENS
Electrical component: Schneider
VFD: AB/SIMENS

The dynamic testing of new type vibrating screen is carried out in screening lab. The testing includes throwing index, amplitude, acceleration, displacement, strain, inherent frequency and model analysis etc.

Key components and parts are matched by experiment platform in order to maximize its efficacy.
Slag-out effect of viscosity soil
Slag-out effect of medium-coarse sand
Service system

1. Technical support of professional technical staff during whole process of construction
2. Professional and efficient site installation team
3. Guarantee of equipment operation in whole process
4. Package mode for spare parts and on-site stock of spare parts
5. Lifetime technical support
6. Fast response guaranteed by nine offices in nine cities
Service system

1. Our company will allocate the project based on each project and confirm the technical staff to provide whole process of technical support. From the selection of equipment in pre-stage of project, layout of equipment on site after purchasing of equipment, civil construction plan, delivery of equipment to installation, commissioning and permanent operation will be followed up by technical staff the whole process.

2. We have professional installation team with abundant experiences and sense of coordination as well as outstanding awareness of safety to assure the equipment to be delivered fast, safe and complete to user.
Service system

3. We will appoint our staff to guarantee the operation of large shield project, to guarantee the timely resolving of malfunction of equipment and operation of shield construction. Meanwhile, we will provide operation and maintenance training to help users to learn how to operate as fast as possible.

4. The spare parts are included in the package bid which will enable contractor to use equipment without concern, and to reduce the worries of contractor. The spare parts will be stocked in warehouse to ensure the timely use.
5. When use in other project, we will provide technical renovation for the equipment, upgrade and complete and restore the service so as to improve the lifetime of equipment and give full play to its value.

6. We have our offices in Beijing, Shanghai, Guangzhou, Kunming, Wuhan, Xi'an, Fuzhou, Chengdu and Shijiazhuang which will response fast within 24 hours on site.
<table>
<thead>
<tr>
<th>No.</th>
<th>Time of turnover</th>
<th>Name of Client</th>
<th>Project name and location</th>
<th>Equipment Mode</th>
<th>Completion of contract status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dec, 2014</td>
<td>Subway Engineering Co., Ltd of China Railway 16th Bureau Group Co., Ltd</td>
<td>TBM project of TJI-5, Phase 1 of Line 1 of Lanzhou Railway, Lanzhou City</td>
<td>ZX-2000</td>
<td>Under operation</td>
</tr>
<tr>
<td>2</td>
<td>Nov, 2013</td>
<td>China Railway 16th Bureau Group Co., Ltd</td>
<td>TBM project of Line 1 of railway of Nanning City</td>
<td>ZX-2000</td>
<td>Under operation</td>
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<tr>
<td>3</td>
<td>Aug, 2013</td>
<td>Guangdong Huasui Construction Co., Ltd</td>
<td>TBM project of line 9 of railway, Guangzhou</td>
<td>ZX-1300</td>
<td>Under operation</td>
</tr>
<tr>
<td>4</td>
<td>Dec, 2012</td>
<td>China Railway 15th Bureau Group Co., Ltd</td>
<td>Bid 2303A TBM project of line R2 of railway in Dongguan</td>
<td>ZX-2200</td>
<td>Completed</td>
</tr>
<tr>
<td>5</td>
<td>Nov, 2012</td>
<td>China Railway 14th Bureau Group Co., Ltd</td>
<td>TBM project of Shouxihu, Yangzhou City</td>
<td>ZX-3000</td>
<td>Completed</td>
</tr>
<tr>
<td>6</td>
<td>Jan, 2012</td>
<td>China Communications 2nd Navigational Bureau</td>
<td>River-crossing tunnel of Weisan Road, Nanjing City</td>
<td>ZX-3000</td>
<td>Under operation</td>
</tr>
<tr>
<td>7</td>
<td>Dec, 2011</td>
<td>CCCC Tunnel Engineering Company Ltd.</td>
<td>River-crossing tunnel of Weisan Road, Nanjing City</td>
<td>ZX-3000</td>
<td>Under operation</td>
</tr>
<tr>
<td>8</td>
<td>Dec, 2011</td>
<td>China Railway 16th Bureau Group Co., Ltd</td>
<td>The Beijing-Tianjin inter-city extension project</td>
<td>ZX-2200</td>
<td>Completed</td>
</tr>
<tr>
<td>9</td>
<td>Nov, 2011</td>
<td>China Railway 14th Bureau Group Co., Ltd</td>
<td>Nanjing subway line10 river-crossing tunnel project</td>
<td>ZX-2000</td>
<td>Completed</td>
</tr>
<tr>
<td>10</td>
<td>July, 2010</td>
<td>China Railway 16th Bureau Group Co., Ltd</td>
<td>Underground diameter line project from west Tianjin station to Tianjin Station</td>
<td>ZX-1500</td>
<td>Completed</td>
</tr>
<tr>
<td>11</td>
<td>Oct, 2010</td>
<td>Sinohydro Bureau 14th Co., Ltd</td>
<td>TBM project of Xijiang Pipeline, Phase 1 of Natural gas pipeline network</td>
<td>ZX-550</td>
<td>Completed</td>
</tr>
<tr>
<td>12</td>
<td>Apr, 2006</td>
<td>China Railway Tunnel Stock Co., Ltd</td>
<td>Wuhan river-crossing tunnel project</td>
<td>ZX-3000</td>
<td>Completed</td>
</tr>
</tbody>
</table>
## Projects in 2015

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Client</th>
<th>Project name and location</th>
<th>Equipment Mode</th>
<th>Geological Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Guangzhou Municipal Group Co., Ltd</td>
<td>TBM project of Bid II, Line 14 of Guangzhou Railway</td>
<td>ZXSII-1750/20</td>
<td>Medium-coarse sand, clayey soil, Completely-weathered(medium-weathered) granite</td>
</tr>
<tr>
<td>2</td>
<td>China Railway First Group Co., Ltd</td>
<td>TBM project of Phase1, Bid 10, Line 6 of Wuhan Subway</td>
<td>ZX-2000</td>
<td>Silty-fine sand and clayey soil</td>
</tr>
<tr>
<td>3</td>
<td>China Construction Communications Engineering Group Co., ltd</td>
<td>TBM project of Bid 1 of New Type Transportation test section in Nanhai District of Foshan city</td>
<td>ZX-650</td>
<td>Silty clay, silt and silty-fine sand</td>
</tr>
<tr>
<td>4</td>
<td>Shanghai Tunneling Engineering Co.Ltd.</td>
<td>Sanyanglu Tunnel, line7 of Wuhan Railway</td>
<td>ZX-3000 (two sets)</td>
<td>Silty-fine sand, strongly(slightly)weathered silty mudstone</td>
</tr>
<tr>
<td>5</td>
<td>China Railway 14th Construction Bureau Co., Ltd</td>
<td>River-crossing tunnel, line 8 of Wuhan Railway</td>
<td>ZX-2000</td>
<td>Silty-fine sand and strongly(slightly)weathered silty mudstone</td>
</tr>
<tr>
<td>6</td>
<td>CCCC Tunnel Engineering Co., Ltd</td>
<td>Bid 6 of Line 2 of Fuzhou subway</td>
<td>ZX-2000</td>
<td>Muddy-silty clay and silt</td>
</tr>
</tbody>
</table>
Typical projects

CCCC Tunnel Engineering Co., Ltd and China Communications 2nd Navigational Bureau construct river-crossing tunnel of Weisan Road, Nanjing City respectively. With diameter 14.96m, Tunnel for the north-south line two bound arrangement, North line is 5337m, the South line is 4755m, Geological condition is mainly of sludge silty clay, silty clay, silt and fine sand, coarse gravel sand, gravel, and parts of moderately weathered silty sandstone. Circulating slurry volume of single line is 3000m³/h and driving speed is 3~5cm/min. The tunneling equipment adopt the slurry balance TBM, adopts two sets of ZX–3000 slurry treatment system, 1st stage cut point d₅₀=50 µm, 2nd stage cut point d₅₀=20 µm.
China Railway Tunnel Stock Co., Ltd construct Wuhan river-crossing tunnel project, with diameter 11.38m, Tunnel length is 2550m, Geological condition is mainly of sludge silty clay, silty clay, silt and fine sand, medium-coarse gravel sand, gravel, Argillaceous sandstone, sandstone and shale. Circulating slurry volume is 1250m³/h and driving speed is 4~6cm/min. The tunneling equipment adopt NFM slurry balance TBM, adopts two sets of ZX–1500B slurry treatment system, 1st stage cut point $d_{50}$=74 µm, 2nd stage cut point $d_{50}$=45 µm.
China Railway 16th Bureau Group Co., Ltd construct the Nanjing subway line No.10 river-crossing tunnel project with diameter 11.64m, Total length is 3600m, Geological condition is mainly of silty clay, coarse gravel sand, Gravel mixed with soil. Circulating slurry volume is 2000m³/h and driving speed is 4~6cm/min. The tunneling equipment adopt Herrenknecht slurry balance TBM, slurry treatment system adopts one set of ZX–2000 slurry treatment system, 1st stage cut point $d_{50}=74 \mu m$, 2nd stage cut point $d_{50}=20 \mu m$. 
TBM project of Shiziyang railway passenger dedicated line of Guangzhou–Shenzhen–Hong Kong.

Completed by China Railway Tunnel Stock Co., Ltd. and China Railway 12th Bureau Group Co., Ltd. The tunnel diameter is 11.12m. The length of North line and South line are 10.8km respectively, Geological condition is mainly of medium-coarse sand, completely weathered- weakly weathered argillaceous siltstone, siltstone, fine sandstone. Circulating slurry volume is 1400m³/h and driving speed is 4~6cm/min. The tunneling equipment adopt NFM slurry balance TBM, slurry treatment system adopts two sets of ZX–1500 slurry treatment system, 1st stage cut point d_{50}=74 µm, 2nd stage cut point d_{50}=45 µm.
Underground diameter line project from west Tianjin station to Tianjin Station

Completed by China Railway 16th Bureau Group Co., Ltd. The tunnel diameter is 11.97m. The total length is 2140m, Geological condition is mainly of silty sand and argillaceous siltstone. Circulating slurry volume is 1500m³/h and driving speed is 4~6cm/min. The tunneling equipment adopt NFM slurry balance TBM, slurry treatment system adopts one set of ZX–1500E slurry treatment system, 1st stage cut point d50=45 µm, 2nd stage cut point d50=20 µm. The slurry treatment system is originally imported KREBS tapered hydro-cyclone and adopts zero discharge treatment.
The Beijing-Tianjin inter-city extension project

Completed by China Railway 16th Bureau Group Co., Ltd. The tunnel diameter is 11.97m. The total length is 2200m. Geological condition is mainly of silty sand and argillaceous siltstone. Circulating slurry volume is 2200m³/h and driving speed is 4~6cm/min. The tunneling equipment adopt NFM slurry balance TBM, slurry treatment system adopts one set of ZXSII–2200 slurry treatment system, 1st stage cut point d50=45 µm, 2nd stage cut point d50=20 µm. Adopts imported KREBS tapered hydro-cyclone and zero discharge treatment with 5 sets of 500 m² of frame filter press.
Completed by Guangdong Huasui Construction Co., Ltd. With diameter 6.26m, The total length is 7256m totally. Geological condition is mainly of the silty sand, medium-coarse sand, gravel sand, silty clay, silt soil, residual soil, argillaceous siltstone, completely weathered limestone, completely weathered argillaceous siltstone, highly weathered limestone, moderately weathered of limestone. Circulating slurry volume is 550m³/h and driving speed is 6-8cm/min. The tunneling equipment adopt two sets of Mitsubishi slurry balance TBM, adopts two sets of ZXSII – 650 slurry treatment system , two lines treatment capacity is 1300m³/h, 1st stage cut point d50=45 µm, 2nd stage cut point d50=20 µm.
Completed by China Railway 14th Bureau Group Co., Ltd. With diameter 6.98m, The lengths of left and right tunnel are 1185m respectively. Geological condition is mainly of the medium-coarse sand, silt clay, silty sand clayey soil, Circulating slurry volume is 950m3/h and driving speed is 6-8cm/min. The tunneling equipment adopt two sets of Herrenknecht slurry balance TBM, adopts two sets of ZXSII – 1000 slurry treatment system, two lines treatment capacity is 2000m3/h, 1st stage cut point d50=45 µm, 2nd stage cut point d50=20 µm.
Completed by China Railway 16th Bureau Group Co., Ltd. With diameter 6.28m, the lengths of left and right tunnel are 2945m respectively. Geological condition is mainly of the medium-coarse sand and sand gravel. Circulating slurry volume is 950m³/h and driving speed is 6cm/min. The tunneling equipment adopt two sets of CRCC slurry balance TBM, adopts two sets of ZXSII – 1000 slurry treatment system, two lines treatment capacity is 2000m³/h, 1st stage cut point d50=74 µm, 2nd stage cut point d50=20 µm. The shield structure is 2 sections every three stops, the slurry system will be removed, so the structure is slurry tank structure.
Comments of clients
Thank You!