

# Cleansing of sewage collectors

## CLEANSING OF THE SAR UPSTREAM OUTFALL

HAUTS DE SEINE DEPARTMENT - FRANCE



### Design of a new sewer cleansing machine and installation of a mobile waste water treatment plant.

**W**ith more than 500km of outfall sewers and collectors transporting the waste water of 8 million inhabitants in the greater Paris area every day, the SIAAP is a key player in the sewer works sector of Paris and its outskirts.

We know that these structures can convey up to 100,000m<sup>3</sup> of effluents every day and this ends up clogging them, in particular on the collector base on which sands and “bulky waste” such as pieces of wood, entangled plastics, concrete blocks are deposited.

In recent years, SIAAP has been issuing calls for tender for the cleaning of these collectors. and, unlike construction works, there have been relatively few innovative technical developments in this type of activity.

And yet, there are very real problems in this sector in terms of the safety of workers, who are exposed to major risks (toxic gases, unsanitary working environment, etc), productivity and effluent management.



Temporary treatment plant

CONTRACTING AUTHORITY:	SIAAP (PARIS)
PROJECT MANAGER:	SIAAP (OPERATIONS DIVISION, SEINE AND WESTERN NETWORKS DEPARTMENT)
CONSORTIUM:	SOLETANCHE BACHY, CSM BESSAC, SOL ENVIRONMENT, SEGEX (CLEANING OF THE ES2B)
SOL ENVIRONMENT'S SHARE IN WORKS:	80%

#### WORK CARRIED OUT:

##### Sewer cleaning

- Length to be cleaned: 6.250km
- Diameter: 3.10 to 3.75m
- Depth: between 10 and 60m below ground level
- Thickness of sand up to 80cm
- 4,500 tonnes of sand to be extracted
- Duration of cleaning: 2 months

##### Safety

- 0 accident

##### Treatment plant

- Treatment capacity 1,200m<sup>3</sup>/day, 150m<sup>3</sup>/hr during peak periods
- Number of days of operation: 145 days (24h/24h)



On the occasion of an invitation to tender by SIAAP for the cleaning of the Rueil branch of the Sèvres-Achères collector, Sol Environment and CSM BESSAC joined forces to propose innovative solutions that would resolve the challenges mentioned above.

### The worksite

The structure concerned by this contract is the upstream section of the SAR, between manhole No. 73 (between Pont de Billancourt and Issy-les-Moulineaux) and manhole No. 54 (between Carrefour de la Bérengère and Saint-Cloud) representing a length of approximately 6,250m. The outfall has a diameter of 3.75m over approximately 3,700m, and a diameter of 3.15m over approximately 2,550m. It is a gravity structure with an average slope of 0.02%.

The work consisted in:

- extracting, transporting and treating cleaning products,
- cleaning access manholes and certain parts of the outfall base,
- treating wastewater that cannot be diverted from the incoming flows of the Marivel brook, by installing and operating a 24/7 mobile plant that complies with the contractual treatment criteria.

The estimated quantity of sand and organic matter deposited is 2,520m<sup>3</sup>.

The main constraints and difficulties of the project are as follows:

- Difficult working conditions and safety of operators:
  - work in a high-risk atmosphere,
  - tunnel work,
  - presence of heavy bodies.
- Very short deadlines (8 weeks of cleaning):
  - extremely long sections of collector to treat (up to 2,500m) until the point of extraction,
  - large volumes of products to extract.
- Protection of the environment:
  - risk of odour nuisances,
  - extracted products requiring a special treatment,
  - water treatment.

To meet these challenges, Sol Environment and CSM Bessac came together and pooled their skills to find a solution to the problems raised. Sol Environment brought its expertise in water treatment and pollution control and its capacities of intervention in polluted environments. CSM Bessac also contributed the propensity of its engineers to invent new tools

and a strong culture of underground works required.

The consortium won the contract based on the innovative aspects of the solutions proposed, together with the competitiveness of the business proposal.

To increase productivity, they decided to separate the cleaning function and the transfer of sand to the extraction hopper into two separate facilities. The two machines, the cleaning machine and the mucking machine, were therefore designed to be as efficient as possible for their function and also include the protection of operators.

In this way, the combination of the two machines guarantees that cleaning is not interrupted with the movements to and from the extraction hopper as is the case with the current technology

### The cleaning machine

The special machine is made up of a self-propelled chassis mounted on radial directional pneumatic tired wheels. At the front end, an armoured conveyor extends forward from the chassis. A cleaning blade and a loading screw are mounted on it. Powered by the thrust generated by the forward machine wheels, the cleaning blade (which can be adjusted





Testing of the cleaning machine on CSM Bessac equipment

to the two diameters –3.15 and 3.75m– of the outfall to be cleaned) penetrates the waste materials to be removed, which are transferred to the armoured conveyor by transverse screw. The materials are then carried to the rear and unloaded into a storage hopper trailed by the cleaning machine. The hopper ensures continuity of outfall cleaning operations during the phases when the waste materials are transported between the cleaning machine and the access shafts.

If the “bulky waste” is not compatible with the conveyor’s evacuation capacities, the operators will have to remove it manually. This operation is facilitated by the integration of a runway fitted with a winch that makes it possible to evacuate the waste to the mucking machine.

Operator safety and protection, ventilation

The machine operator sits in a protected cab with overpressure ventilation. The forced ventilation protects the operator from any gases and odours generated. The cab ventilation air is piped in from the surface.

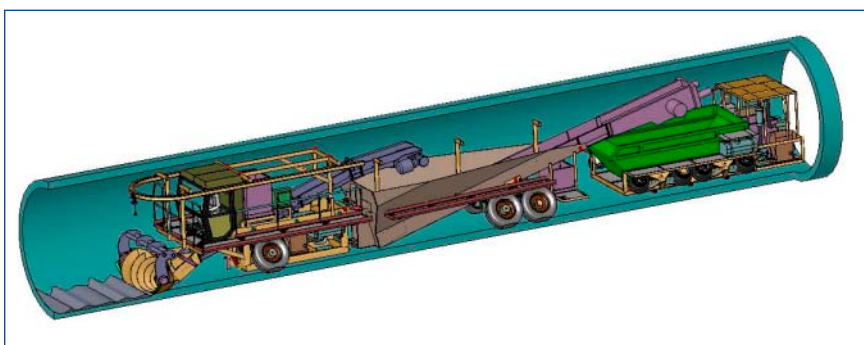
In addition, collective ventilation is provided by an over-dimensioned fan (18m<sup>3</sup>/s at the intake) which forces air through the collector. Thus emissions of H<sub>2</sub>S gas (present in the sands) as well as CH<sub>4</sub> and CO are blown forward from the machine and thus away from the machine operators. This efficient collective protection ensures that working conditions are highly satisfactory in terms of operator safety, despite the fact that exposure to these gases can be fatal.

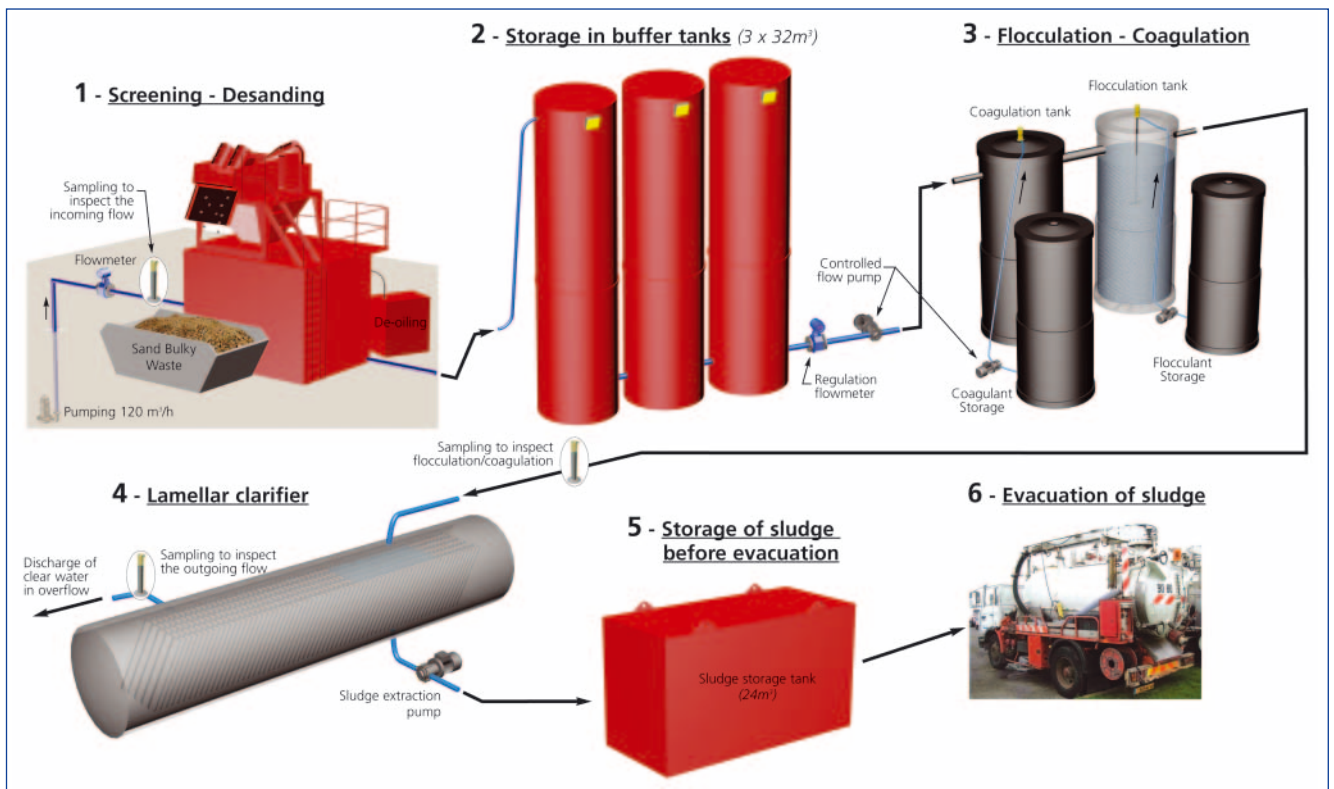
Power

The cleaning machine is powered by a diesel engine fitted with an exhaust catalytic converter in which gases are channelled through a scrubbing unit and the electrical system is treated with flame-proofing.

**Mucking machine**

Like the cleaning machine, the mucking machine is designed to be used in tunnels of various diameters (between 3.15 and 3.75m). The chassis is equipped with 8 wheels and carries a 5 cu. metre movable skip. The machine is powered by a diesel engine identical to the one fitted on the cleaning machine. A hydraulic transmission shaft connects to the drive wheels. The operator’s position is set perpendicular to the direction of travel of the mucking machine to facilitate visibility in both directions (forward and backward). The machine is equipped with gas detectors and personal respiratory equipment is available for the operator in the cab. To remove sludge collected by the cleaning machine, the mucking machine with an empty skip takes up a position at the rear of the storage hopper. A transfer conveyor unloads the storage hopper. Once loaded, the mucking machine returns to the working shaft where its skip is removed and replaced with an empty one by means of lifting apparatus mounted on the surface.





The sludge recovered is taken to treatment plants duly authorised for the treatment of these materials.

**A temporary purification plant for a city of 5,000 inhabitants**

To take the portion of the collector to be cleaned out of operation, SIAAP arranged for those incoming flows that could be channelled to other parts of its network.

The contribution of the Marivel brook, amounting to approximately 1,200 cu. metres per day, the equivalent of the waste water produced by a city with a population of 5,000, could not be diverted during the project. That is why SIAAP decided, for the first time in this type of operations, to set up a temporary purification station to treat this waste water, rather than discharge untreated water directly into the Seine River.

This station was designed by Sol Environment teams to comply with the discharge objectives set by SIAAP and the Seine Navigation authority in terms of suspended matter (70% reduction), organic content (50% reduction), and phosphorous (50% reduction).

The main treatment steps installed in this plant were as follows:

- pre-screening and pumping into the network at a maximum capacity of 150m<sup>3</sup>/h,
- screen at the inlet to remove bulky waste,
- de-oiler,
- de-sanding using a hydrocyclone at a capacity of 150m<sup>3</sup>/h,
- buffer storage of water containing fine particles in three tanks each with a capacity of 32m<sup>3</sup> to ensure that the incoming water is levelled,
- followed by physical and chemical treatment of fine particles through

coagulation, flocculation and lamellar settling to generate sludge that can be removed through compliant channels.

The full range of this equipment was designed to be rapidly installed in cramped areas with minimum odour, noise and visual impact. Located on the banks of the Seine near the Pont de Sèvres bridge, without any nuisance or any complaints, the station has been well accepted by strollers and owners of nearby barges.

The station operates 24 hours a day, 7 days a week and was designed to ensure reliability and safety. Processes are automated, key parts (pumps, generator sets, etc.) are redundant, operating parameters have been recorded and the station is in constant touch with a team that is on call at all times, with GSM transfer of any alarms.