Photos of work site

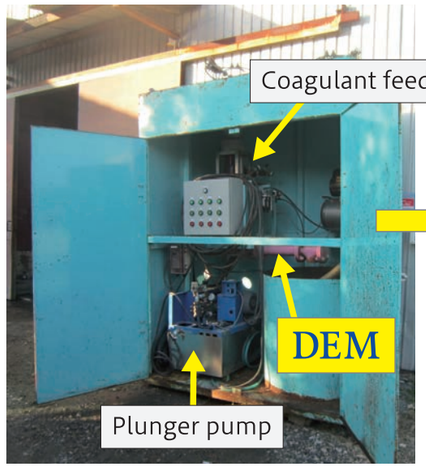

Photo 18 Coagulant feeding facility

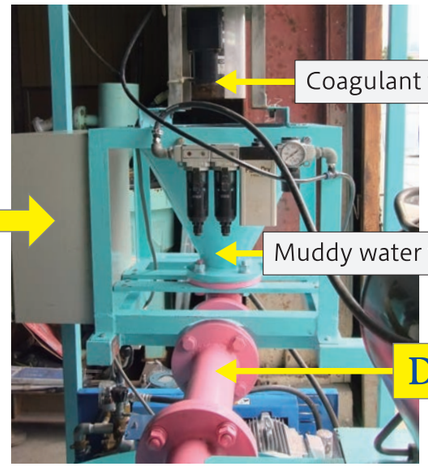

Photo 19-1 Insideof facility

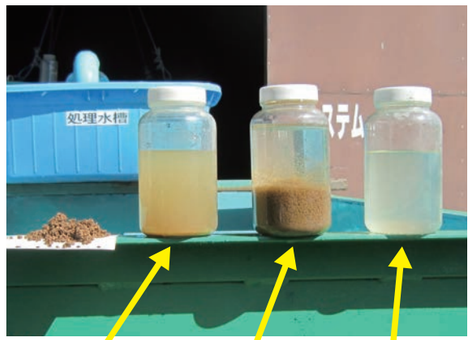

Photo 20 Samples

Photo 19-2 Insideof facility

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Distinctive Feature of DEM

Written by DPK

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1. Introduction

DPK is the abbreviated name for Dojo-Kankyo Process Institute, Yokohama city, Japan.

DEM is the registered trademark of the mixer which DPK invented 8years ago.

DEM is a high pressure jet device which had originally been applied for washing soil contaminated with insulation oil, resulting in high performance of both an extremely short time to eliminate oil and the recovery rate. DPK supposes that the mix mechanism of DEM is alone in the world.

As the other case, it is possible to mix water with something like liquid or powder, and DPK has achieved the development of several application units of DEM, having the patent rights in Japan.

DPK explains the mix mechanism of DEM and the examples of using DEM in this pamphlet.

2. Mix Mechanism of DEM

Fig1 illustrates flow inside DEM.

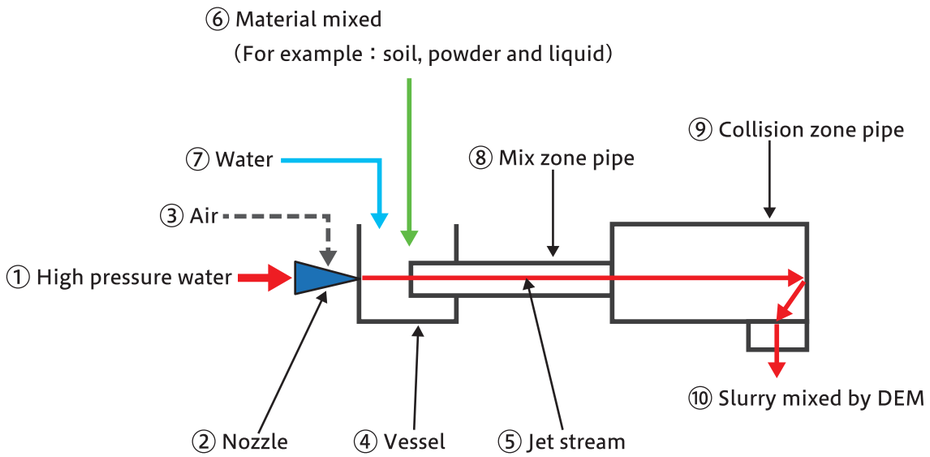


Fig 1 Flow inside DEM

The following explains about fig1.

1. The high pressure water ① flows through the nozzle ② which is installed at the vessel side wall ④ of DEM, and changes to the jet stream. ⑤
2. This high pressure water is generated by a plunger pump which pressure is 2 or 3 Mpa.
   The velocity of jet stream is about between 50m/s and 100m/s.
3. The jet stream contains external air which is drawn by vacuum generated on surface of jet stream.
4. The material ⑥ and water ⑦ are flowed in the vessel of DEM.
5. The material, water and air mix together and accompany the jet stream.
6. The turbulent flow of the mix appears in the mix zone pipe. ⑧
7. The terminal mix is completed in the collision zone pipe. ⑨
8. The slurry ⑩ is the production of DEM.

3. Stream State inside DEM

Fig2 illustrates diagram of stream flow inside DEM. Photo1 indicates stream state inside DEM made of plastic to observe the stream state, then the simulant fluid used the plastic particles instead of soil.
Fig3 and fig4 are the result of shear stress appeared in stream being calculated by a super computer.

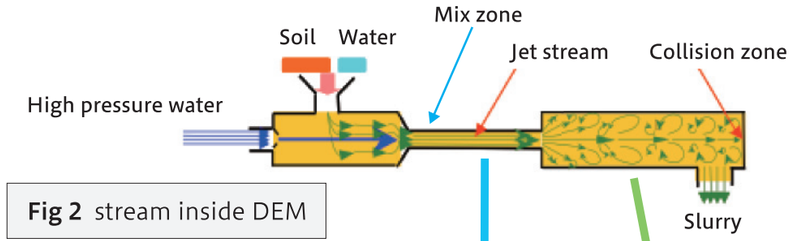


Fig 2 stream inside DEM

Photo 1 Visual model flow

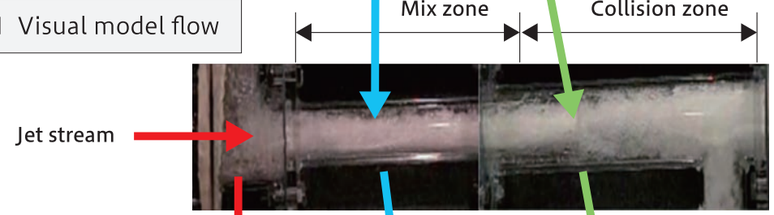


Fig 3 Shear stress of stream by simulation

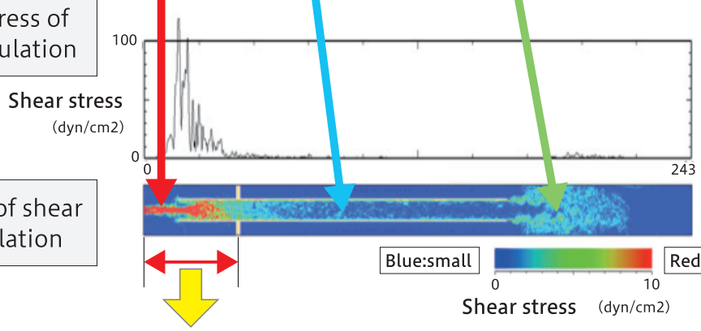


Fig 4 Picture of shear stress by simulation

When the jet stream through the nozzle contacts with material mixed water, the large shear stress appears in the stream at the entrance portion of mix zone.
If material mixed is soil, it is dispersed suddenly to its particles in water.
This phenomenon is approved by the experiment which DPK achieved with Tokyo Electric Power Company.

4. Dimension of DEM

The dimension of DEM is decided according to the material mixed and the quality target of product.

Table1 is the data which DPK designed actually for washing soil to eliminate contamination.

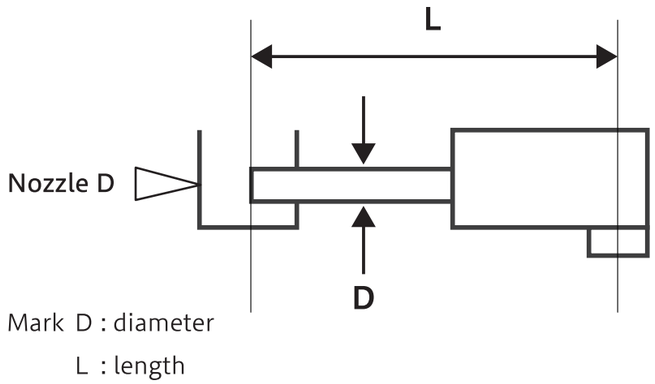


Fig 5 Dimension mark of DEM

Capacity kg ／ hr	D mm	L m	Nozzle D mm
15,000	65	2	4.5
3,000	40	1	2
600	20	0.6	1.2
100	10	0.4	0.8

Table 1 Dimension of DEM

5. Conceptual Diagram of Washing Soil

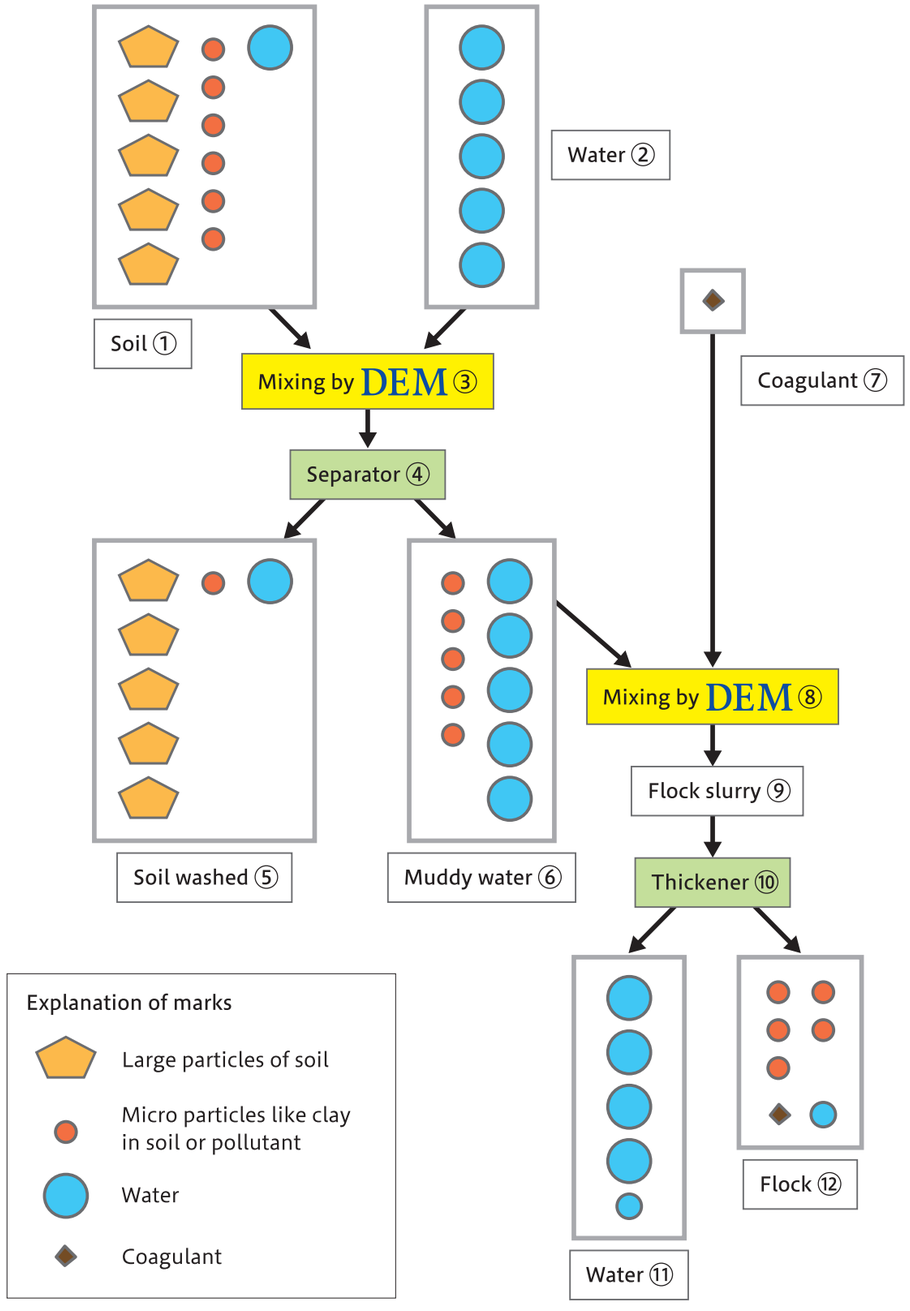


Fig 6 Conceptual diagram for washing soil

The following explains about fig6.

Soil ①　: Composition of soil is illustrated by 3 materials which are large particles of soil, micro particles like clay or pollutants and contained water. The pollutants are oil, organic solvent, arsenic etc.

Water ② : This water is added to soil ① for diluting it.
In fig6, water ② is 5times of contained water of soil.

Soil ① and water ② are mixed by DEM ③ and followed by Separator ④
Then the micro particles or pollutants are conducted in 6 dilution magnification.

After soil washed ⑤ and muddy water ⑥ are separated by separator, amount of micro particles or pollutant in soil washed ⑤ is decreased to (1/6) of initial content.

If water ② is more than 5times of contained water, soil washed becomes more clean of course.

Muddy water ⑥ is mixed with coagulant ⑦ by DEM ⑧, so flock slurry ⑨ is formed soon.

Flock slurry is separated to flock ⑫ and water ⑪ by thickener ⑩

Water ⑪ is almost clear, so it is reused as water ②, and the flock ⑫ is managed according to the content of flock.

6. Practical Examples

6.1 Photos of DEM

Photo 2
DEM for washing soil contaminated with fluorine.
Capacity 15,000 kg/hr/line

Photo 3
DEM for washing soil contaminated with radioactivity.
Capacity 3,000 kg/hr

Photo 4
DEM for experiment unit.
Capacity 600 kg/hr

Photo 5
DEM for experiment unit.
Capacity 100 kg/hr

6.2 Mixing soil and water for elimination of contaminated oil.

When the pipe line in nuclear power plant of Tokyo Electric Company was ruptured by Chuetuoki earthquake, Niigata city, the insulation oil flowed to the underground soil of the power plant. The oil content in it was about between 5000ppm and 2% by weight.

For the purpose of the elimination of it, DEM was used to mix the underground soil and water, followed by separation of oil in water. As a result, oil content of the soil was reduced to less than 250ppm.

The capacity of the washing soil plant is 30,000kg/hr.

The amount of soil washed was 30,000ton which was buried again in the underground of plant.

DPK received the prize of Japan Society of Civil Engineers for this achievement with Tokyo Electric Company.

The block flow sheet in fig 7 was actually used in the plant mentioned.

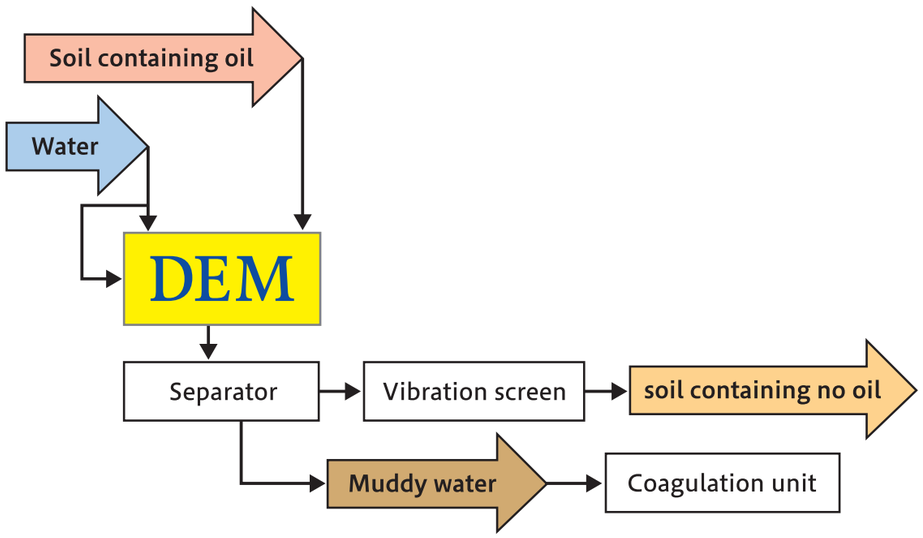


Fig 7 Block flow sheet

Photos of work site

Photo 6 Plant view

Photo 7 Soil charged by power shovel

Photo 8 Upper hopper of DEM

Photo 9 Soil treatment capacity: (15,000kg/hr)/umit

Photo 10 Soil containing no oil

6.3 Mixing field sand and water for elimination of micro particles in it.

One of the most famous sweet potatoes in Japan is NARUTOKINTOKI, trade mark, which is grown in the field, being composed of sand, located beside Yoshino river mouth, Tokushima city.

The particles of sand were crushed for long time by the cultivators, so the quality and the harvest of it degraded year by year. Tokushima Agriculture Research challenged to solve the subject for about 40years, but could not find any method.

DPK washed the sand using DEM and succeeded in the elimination of micro particles. At the result, both the quality and the harvest were restored to the best data immediately by the good breathability of sand.

DPK washed the sand according to the process of fig6 and the efficiency of it was judged by residue of particles under 0.1mm diameter.

Particle size accumulation curves, fig7and fig8, were created for the field sand and washed sand. From these data, table2 was created.

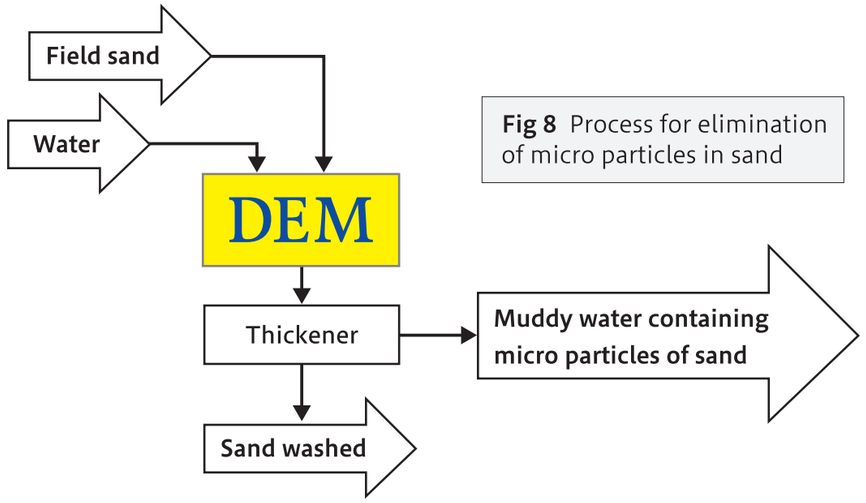


Fig 8 Process for elimination of micro particles in sand

Table 2
Contamination ratio of sand

Sample	Contamination ratio
Field sand	9%
Sand washed	1%

Contamination ratio means the amount of micro particles which diameter of it is under 0.1mm.

Fig 9 Particle size accumulation curve(Ⅰ)

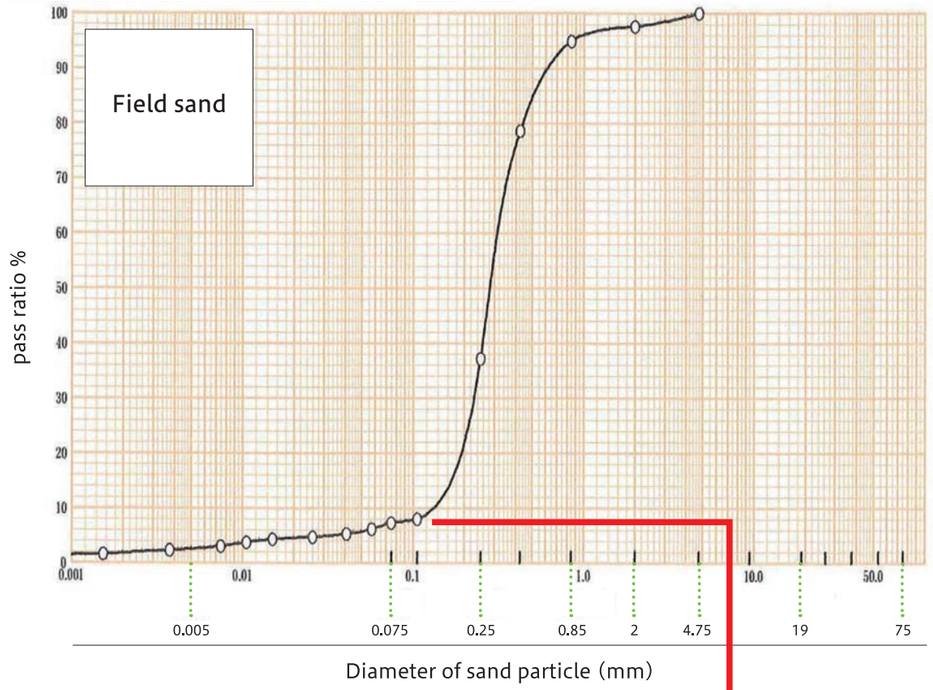
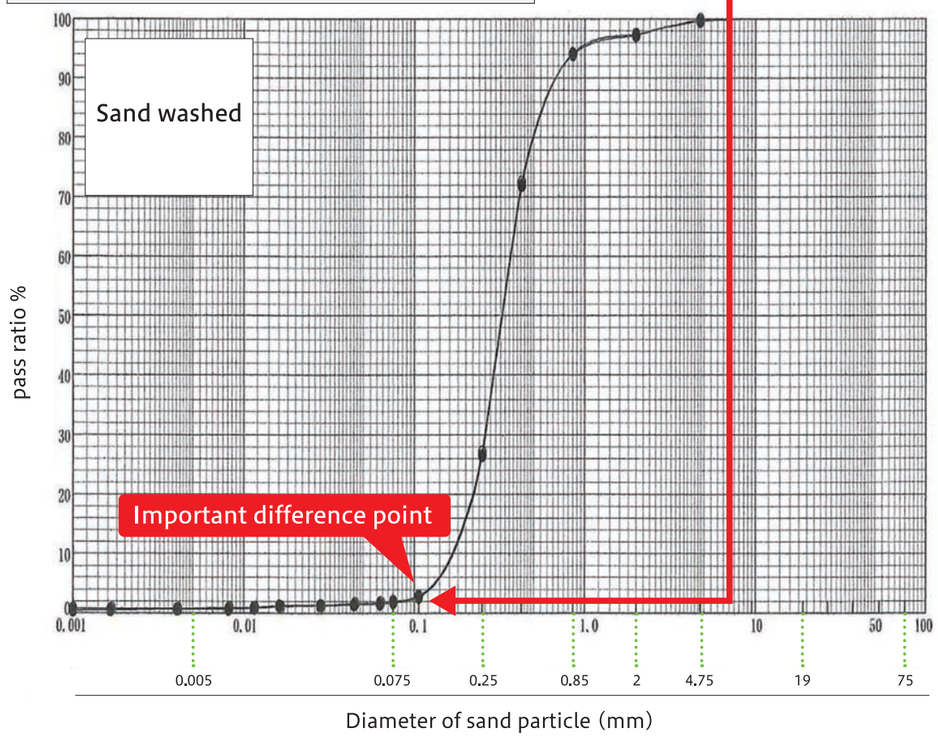


Fig 10 Particle size accumulation curve(Ⅱ)



Photos of work site

Photo 11 plant view

Photo 12 DEM

Photo 13 Thickener

6.4 Mixing sand in sandboxes and water for elimination of baclli

Many sandboxes are set usually in the open, so sand of them is smudged by excreta of dogs and cats. Many methods to eliminate bacilli are proposed, for example fungicide sterilization, steam sterilization, covering sandboxes with vinyl sheets, sand replacement etc.

But these methods have the weak point, for example fungicide being bad for children health, the carcass of bacilli being left etc.

DPK proposes the original method using DEM to eliminate these weak points. It is DPK process in which sand contaminated with bacilli is mixed with only water by DEM and finally sand and muddy water containing bacilli are separated continuously in a vessel. In the vessel, the washed sand sinks and muddy water containing bacilli overflows.

In this case, the unit for mixing sand and water is developed, so main equipments are set on the small cart. Its side view is shown in fig11.

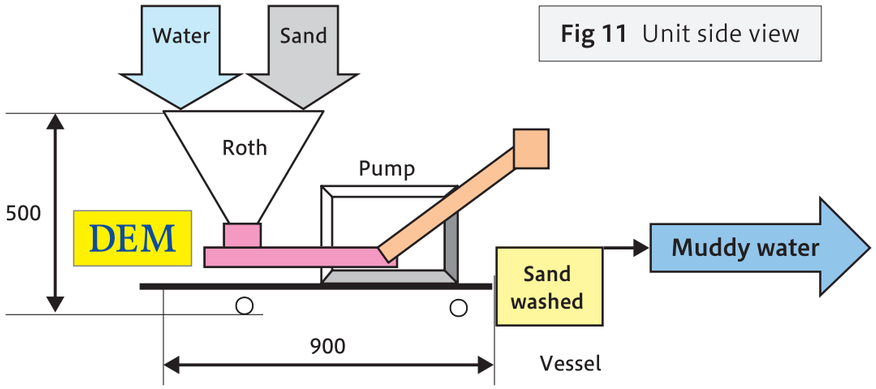


Fig 11 Unit side view

Sand washed is returned to sandbox directly and muddy water is cleaned by the aggregation operation in a small tank with mixing of about 1minute.

Photo 14 Unit

Spec
Capacity sand 1500kg/hr
Size 900length×600wide×500high

Table 3 Result of bacilli elimination by unit

Sandbox place	Number of colitis germ legions (number/gr)		Elimination ratio
	Original sand (A)	Sand washed (B)	{(A-B)/A }×100%
Park in Tokyo	15,000	50	99%
		800	95%
	3,200	170	95%
Kindergarten in Tokyo	2,400	24	99%

Photos of work site: Kindergarten in Tokyo

Photo 15 Washing sand unit

Photo 16 Slurry, containing sand and water from DEM

Photo 17 Sand washed

6.5 Mixing coagulant and muddy water

DPK has constructed the coagulant feeding facility equipped with DEM capacity 30m³/hr. Of course, more big capacity facility will be designed.

The muddy water in operation contains the particles of soil at a concentration of 3,000ppm ～ 10,000ppm.

The amount of coagulant adding to muddy water is about 100ppm of its volume. The coagulant is inorganic which is used usually in the aggregation operation field of muddy water.

The facility is very compact because of the realization of small mixer by DEM.

The coagulant feeding facility is assembled according to the process flow illustrated in fig10.

Fig 12 Process flow of coagulant feeding facility