HIGHER SEPARATION EFFICIENCY

Higher separation efficiency for dredged material, sieve sand and soil by using pulsating bed separation.
Abstracted from the article of the same name, written by Ir. M.K. de Kreuk (MTI Holland), Ir. J.F. de Kreuk (Biosoil R&D) and Ir .H. van Muijen (MTI Holland), published on the occasion of the Technology2000 symposium "Grond Zeefzand en Baggerspecie, grondstof voor nuttig toepasbare producten" (10 September 1998, Amsterdam).

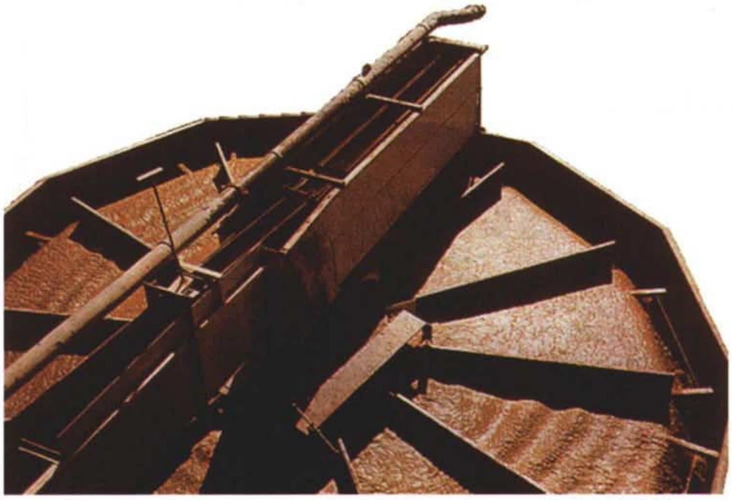

Figure 1
Twelve working pulsating bed units, placed in a circle

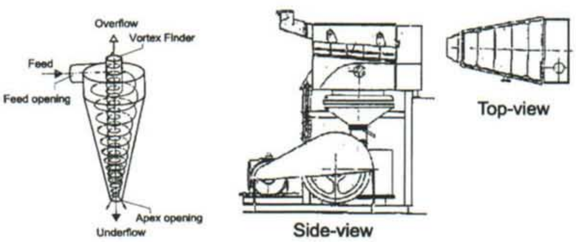

Figure 2 a) b)
Hydrocyclone with the movement of the different flows (a)
IHC Laboratory Jig, which was used for the experiments (b)

INTRODUCTION

Pollution of solid materials, such as dredged material, soil and sieve sand, often occurs in certain specific fractions or as particles. The problem can be partially solved when the contamination is concentrated in a certain part of the material (fines and/or organic particles). This can be achieved by using classification (division on size), sorting (division on density) or a combination of the two.

An investigation was carried out by MTI Holland BV, Biosoil R&D and KEMA, within the framework of the Dutch government research program "Technology 2000" sponsored by the Ministry of Environmental Affairs. The aim of the investigation was to test a pulsating bed separator and achieve a higher purification efficiency for the fraction <2 mm of polluted dredged material, soil and sieve sand as compared to conventional techniques such as hydrocyclones.

Table 1 Differences between a hydrocyclone, fluidized bed separator and pulsating bed separator

	Hydrocyclone	Fluidized bed separator	Pulsating bed separator
Separation mechanism	Centrifugal and friction forces	Hindered settling and suspension density	Hindered settling and specific particle density
Particle separation	On mass	on specific density, particle diameter	On specific density, particle diameter
Particle separation point	2 mm-250 mm (depends on size of the cyclone)	> 100-125 mm, (> 60 mm is possible)	> 30 mm
Separation density	---	< 1600-1800 kg/m3	< 2000-2200 kg/m3,
Operation	Sensitive to concentration of fines	Sensitive to influent density	Insensitive to fluctuations in the feed
Separation efficiency for PAHs	Low	High	High
Water consumption	High (water recycling 5%)	High, no water recycling	Low, (up to 65% water recycling)
Energy consumption	High (feed to cyclone with high pressure)	Low (pumps)	Low (pumps and motor to induce pulse)
Common in	All kinds of separation applications (e.g. sand and chemical industry)	Sand industry, environmental applications	Mining, coal and secondary raw material industry

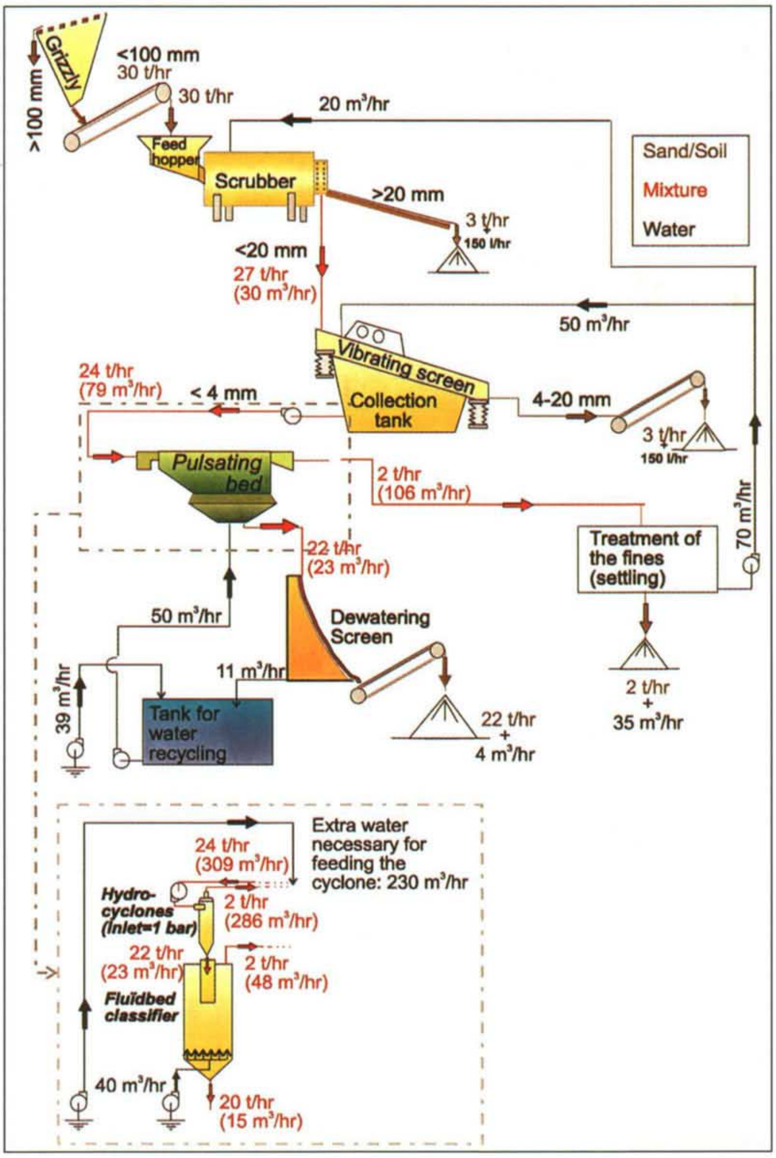

Figure 3
Flowchart of an installation for the treatment of contaminated dredged material

HYDROCYCLONE VERSUS THE PULSATING BED SEPARATION

The most commonly used separator in the treatment of contaminated materials is a hydrocyclone. Because of the combined sorting and classifying operation, as presented in table 1, particles with the same mass, but with different diameters and densities, will end up in the same flow. This means that large polluted organic particles will be included in the (unpolluted) underflow (sand fraction), which gives a limitation to this cleansing method. Therefore, the hydrocyclone is often utilised in combination with a fluidised bed classifier. Instead of using this combination, the same result is obtained by using a pulsating bed separator (figure 2), which is easier and cheaper to operate (table 1).

The possible use of a pulsating bed in a commercial operation is shown in the flowchart and mass balance of figure 2. The pre-treatment involves scrubbing and removing particles larger than 4 millimetres. The other particles and the process water can be fed to the pulsating bed. Recycling of process water is possible, because the efficiency of the separation hardly depends on the amount of fines in the feed. This is a crucial difference with the use of a hydrocyclone and a fluidised bed separator. Furthermore, the latter plant needs more water in general as well: the feed of the cyclone is less concentrated than the feed of the pulsating bed (1.05 instead of 1.2 tons/m3) and the fluidised bed separator needs upflow water. The costs for water treatment of the pulsating bed are therefore significantly less than where hydrocyclones are used. Also the energy consumption will be higher when cyclones are involved (figure 3, frame).

THE EXPERIMENTS

To prove the expected advantages of the pulsating bed separation, 5 different types of soil were tested on a laboratory scale (0.5 ton/hr); 2 types of dredged material from a depot for the storage of polluted dredged material; "de Slufter" (a coarse and a fine equivalent), sieve sand, soil from a wood impregnation site (creosote pollution) and soil from a breaker's yard, (heavy metal pollution, characterised as non-treatable).

From all the treated materials, except the creosote soil, the coarse underflow (90% of the total amount) could be re-used as a category I building material according to Dutch regulations (1998) and in some cases even a category I soil. This result was achieved after only one stage.

During the test with the sieve sand, an unexpected advantage of the pulsating bed separation was shown. The material contained asbestos, which was only found in the polluted overflow together with the heavy metals and the PAH's after separation.

CONCLUSIONS

From all the tests performed, the following main conclusions can be made:

- The separation points of a hydrocyclone and a pulsating bed are comparable (40 mm);
- The pulsating bed has high separation efficiency for PAHs;
- The water economy of the pulsating bed is much more efficient than that of a hydrocyclone;
- The treatment of contaminated materials with a hydrocyclone is mostly carried out in combination with a fluidised bed classifier. Pulsating bed separation combines these two methods to one apparatus, so the material can be handled in one stage;
- The total process costs of a pulsating bed are lower.
- By using the pulsating bed, the retrieved PAH, metal and mineral oil concentrations in the coarse fraction are low enough to use these fractions as a category I building material, after only one clarification stage.