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REPLACEMENT OF THE FINAL SETTLING BASIN BY A FLUIDIZED PELLET BED SEPARATOR TO IMPROVE EFFICIENCY OF ACTIVATED SLUDGE SYSTEM

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ABSTRACT

A new high rate separation technology, i.e. a fluidized pellet bed separation of activated sludge, is proposed to improve conventional activated sludge treatment system and the related dewatering process.

KEYWORDS

Activated sludge system; agglomerates, fluidized pellet bed separator, sludge thicking, dewatering

HIGH RATE SEPARATION BY A FLUIDIZED PELLET BED SEPARATOR

As shown in Fig. 1, an experimental apparatus is composed of a fluidized pellet bed (pelletizer) column to generate pellet-like large and dense agglomerates, and a separation column (ϕ10 cm, H220 cm). Optimal operation conditions of pelletizer are shown in TABLE 1. Cationic polymer is added at the inlet of the pelletizer. A weak agitation is given by agitation paddles in order to enhance higher density and sphericity of

TABLE 1 Optimal operation conditions of pelletizer

Up flow velocity	30 ~ 60 cm/min
Detention time	6 ~ 3 min
Rate of paddle rotation	30 ~ 40 rpm
Cationic polymer dosage	10 ~ 20 mg/ℓ

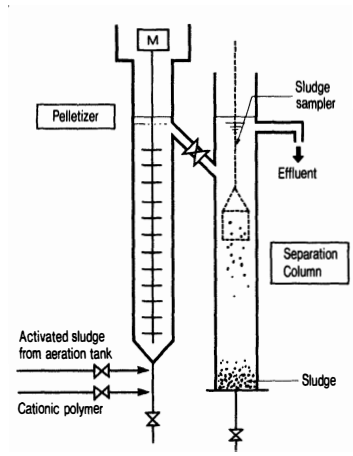

Fig. 1. Experimental apparatus

the agglomerates. By the operation, good shaped pellets like agglomerates with high density are generated in the pelletizer. Surplus sludge overflows to the separation column. In the column, the effluent is overflowed and pellets subside with free settling mode. Photo 1 shows the agglomerates generated in the pelletizer. As shown in Fig. 2, the density of the agglomerates decreases with particle size on the Tambo and Watanabe's floc density function. By the result, this agglomerate is considered to be a kind of random floc. However, the density is twice as high as that of ordinary activated sludge particles. Hence, we can have high overflow rate in the pelletizer. TABLE 2 shows a series of experimental results by the pelletizer.

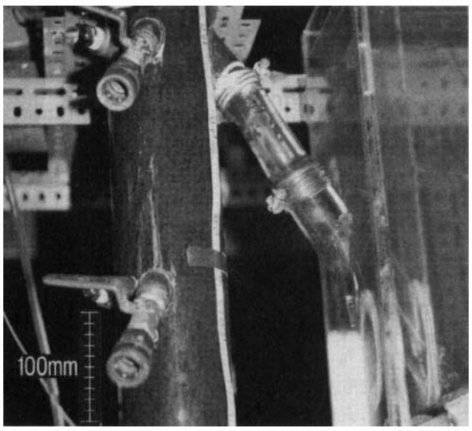

Photo 1. Agglomerates generated in the pelletizer

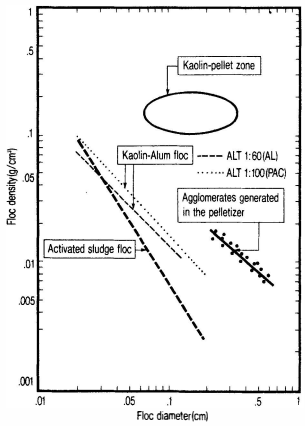

Fig. 2. Floc density vs floc diameter

TABLE 2 Experimental results by the pelletizer

MLSS of activated sludge	1,500 ~ 2,000 mg/ℓ
Sludge concentration in the pelletizer	10,000 ~ 15,000 mg/ℓ
Mean size of the agglomerates	5 ~ 10 mm
Effluent turbidity	3 ~ 5 mg/ℓ
BOD in the effluent	2 ~ 5 mg/ℓ

PRACTICAL USE

Sludge dewatering

This fluidized pellet bed process is not only useful for separation to get a good effluent in a short time, but also is simultaneously useful for thickening process for sludge dewatering without any additional dosage of polymers.

Agglomerated pellets are discharged into the wet filter softly on a filter cloth in a water basin. The filter cloth runs with the velocity of 0.5 m/min and conveys the discharged sludge upward and squeezes for dewatering in a few mins. A practical fluidized pellet bed separation and dewatering machine which can be used for a sludge dewatering system is already on the market as shown in Fig. 3. This system is composed of Pelletizer, Wet filter and Belt filter press.

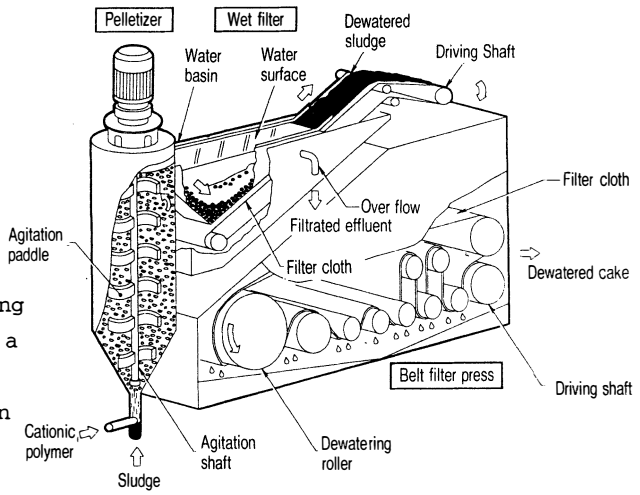

Fig. 3. Typical structure of sludge dewatering system

The operational data compared with the conventional process is shown in TABLE 3. The belt filter is 0.5m wide. The data prove that the system is effective for sludge dewatering.

TABLE 3 Comparison of operational data of proposed system and conventional process

Condition	Mixture of raw sludge from conventional activated sludge process		Excess sludge from oxidation ditch process	
	Proposed system	*Conventional process	Proposed system	*Conventional process
TS in feed sludge	1%	2%	1%	2%
VTS in feed sludge	65 ~ 75%		65 ~ 80%	
Polymer dosage of TS	0.4 ~ 0.8%	0.6 ~ 1.2%	0.4 ~ 0.8%	0.8 ~ 1.5%
Filtration rate	100~150kg/m·H	70kg/m·H	50~100kg/m·H	50kg/m·H
Moisture content of the dewatered sludge	70 ~ 77%	76 ~ 83%	75 ~ 80%	80 ~ 85%
SS capture	95 ~ 99%	95 ~ 98%	95 ~ 99%	95 ~ 97%

* Conventional process: Gravity thickening and Belt filter press.

High-rate:high-loading process in the aeration tank

The fluidized pellet bed separation to innovate conventional activated sludge system can be designed as the schematic chart in Fig. 4. The dewatered fresh sludge can be used as the return sludge to the aeration tank as well as to discharge for disposal. The extra high concentration of the dewatered sludge enables to increase MLSS in an aeration tank to a very high level when it is returned. Oxygen processes and other high pressure aeration processes can be used effectively.

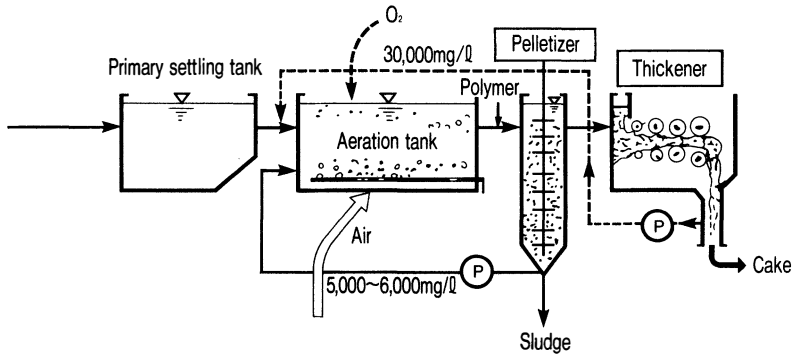

Fig. 4. Proposed system to improve conventional activated sludge system

CONCLUSION

This fluidized pellet bed separator is useful for separation of activated sludge in a few minutes, and useful for thickening process for sludge dewatering as well.

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