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PHOSPHORUS REMOVAL FROM WASTEWATER USING DISSOLVED AIR FLOTATION

Introduction

The water quality problems related to increasing phosphate content in wastewater, which stimulates aquatic plant growth and contributes to eutrophication process, leads to more stringent WWTP effluent total phosphorus concentrations requirements.

Dissolved air flotation (DAF) is a feasible tertiary treatment technology for the removal of phosphorus. KWI decided to conduct pilot tests and case studies in several treatments plants to determine the efficacy of using the KWI enhanced KWI DAF technology as well Combination of DAF Process and filtration.

Pilot and case studies goals

– Evaluate treatment performance of the DAF technology for phosphorus removal;

– Evaluate the chemicals consumption;

– Develop efficient design of DAF technology for phosphorus removal.

Principle of UI elements

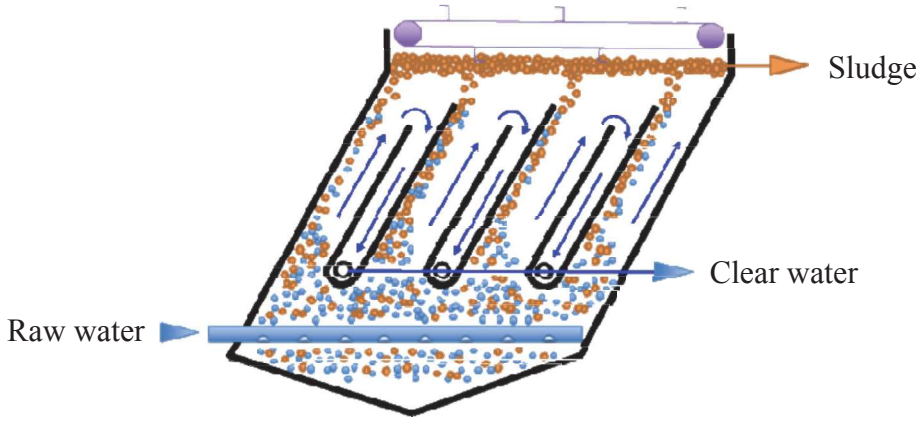


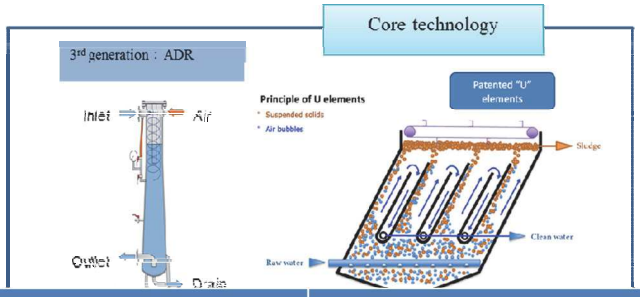
Figure 1

The core technology of KWI‘s Megacell® series is a U-shaped plate placed side by side, which allows the same flow and reverse flow solid-liquid separation similar to the lamellar clarification, achieving high hydraulic load and solid load. This technology provides efficient treatment with less energy consumption.

Pilot test results of phosphorus removal

The pilot equipment was integrated at One WWTP in Kunming with capacity 120.000 m^3/day in 2018. The target of outlet TP concentration was 0.05 mg/l.

The pilot system consists of DAF tank with U elements and scoop, 3rd generation Air Dissolving Reactor and chemicals feed equipment.



MCV pilot		Composition	
Hydraulic load	23 m/h	DAF tank	U elements + Scoop
Max inlet flow	9 m^3/h	Air dissolving system	ADR
Retention time	6.7 min	Chemicals	PAC、PAM

Figure 2

Major factors affecting phosphorus removal by DAF

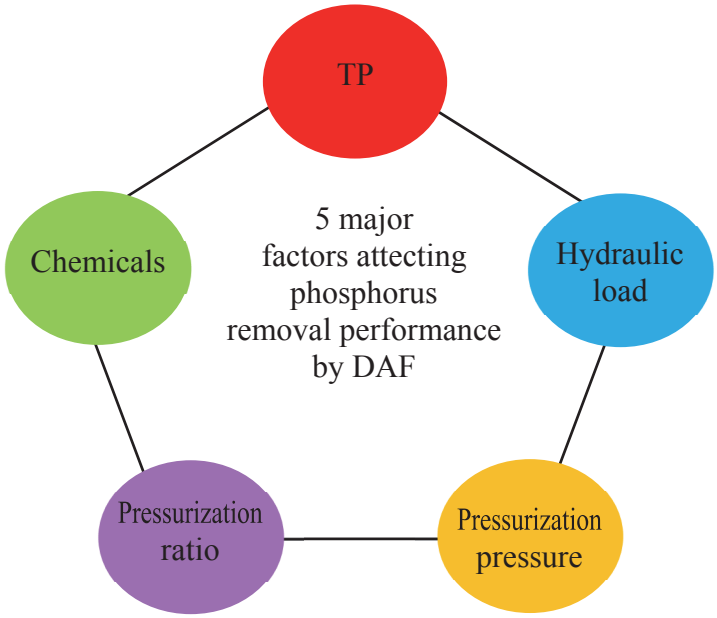


Figure 3

Chemicals consumption

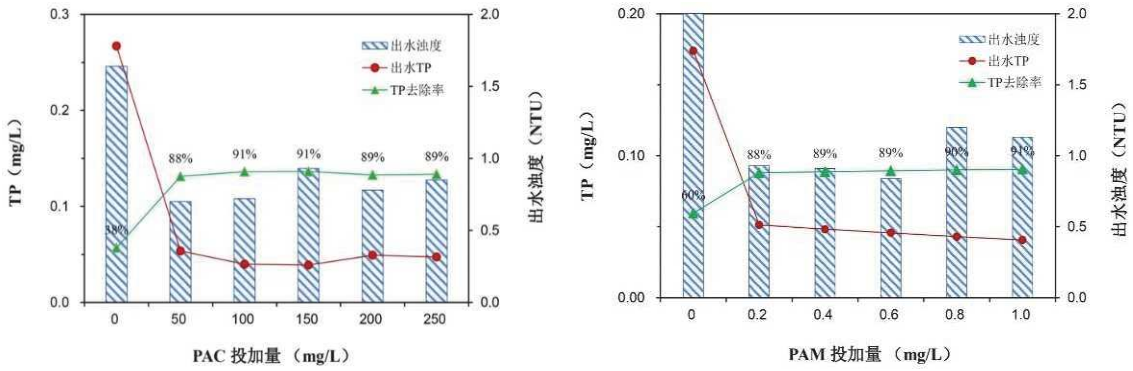
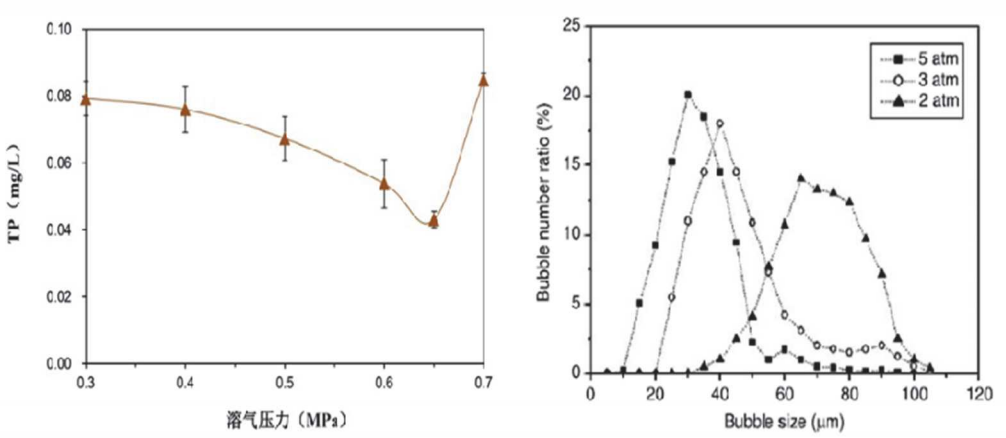


Figure 4

When Outlet P ≤0.05 mg/l, outlet turbidity <1 NTU.
Effective content of PAC is 10 %.

Pressure of dissolved-air water



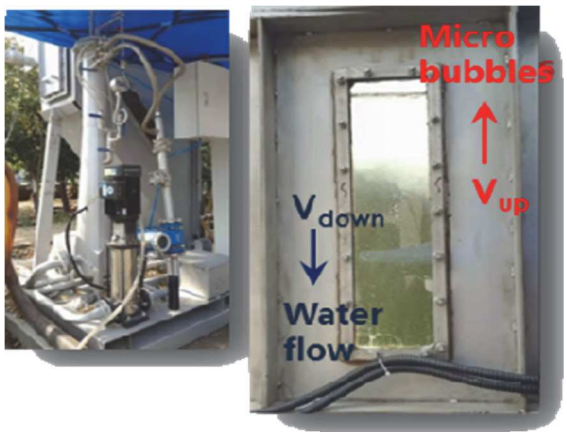


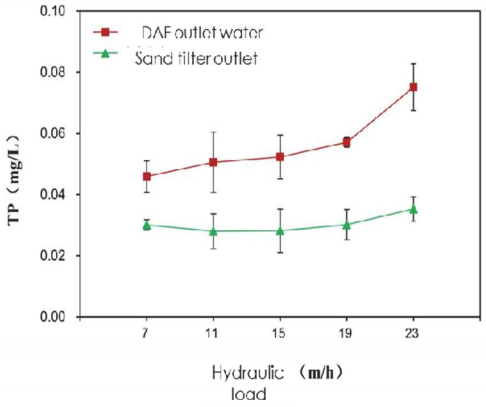
Figure 5

Henry's Law: At a constant temperature, the solubility of the gas in the liquid is proportional to the equilibrium partial pressure of the gas.

Micro-bubbles are not as small as possible to achieve the best performance. The smaller the bubbles, the slower the rising velocity. When $V_{up} > V_{down}$, the air flotation separation effect is better.

Hydraulic load

The amount of water per unit surface area of the separation zone of the DAF tank (excluding recycled pressurization water) per unit time.



Q (m^3/h)	q (m/h)	HRT (min)
3	7	20
4.5	11	13.3
6	15	10
7.5	19	8
9	23	6.7

Figure 6

Recycle ratio of pressurization water.

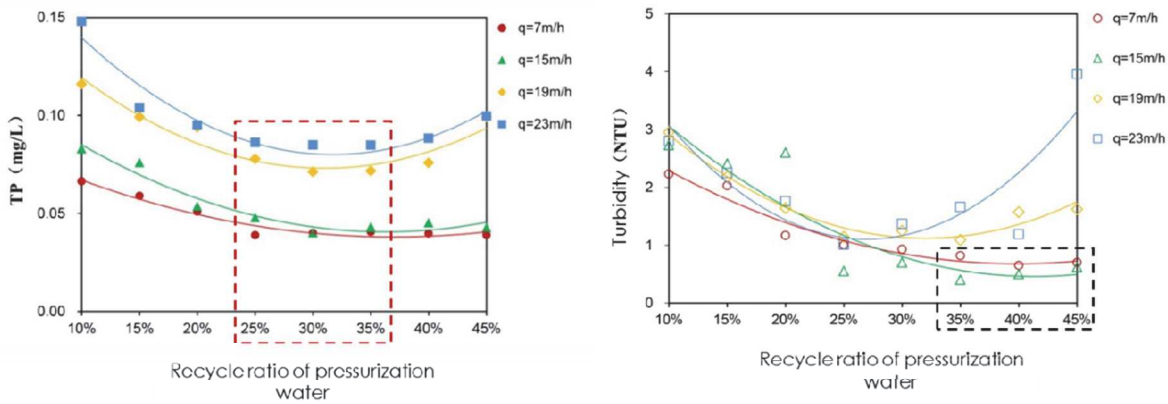


Figure 7

Conclusion

According to inlet water quality (TP: level 1 A = 0,5 mg/l) and MCV DAF pilot equipment:

– the target of 0.05 mg/l outlet TP can be achieved by chemical phosphorus removal, however, the requirement of solid-liquid separation performance is very high (outlet turbidity <1 NTU). Increasing the hydraulic load leads to an

increase of water flow, making it difficult to achieve fine solid-liquid separation;

– after the secondary sedimentation tank, add the process of "chemical phosphorus removal + MCV DAF solid-liquid separation".

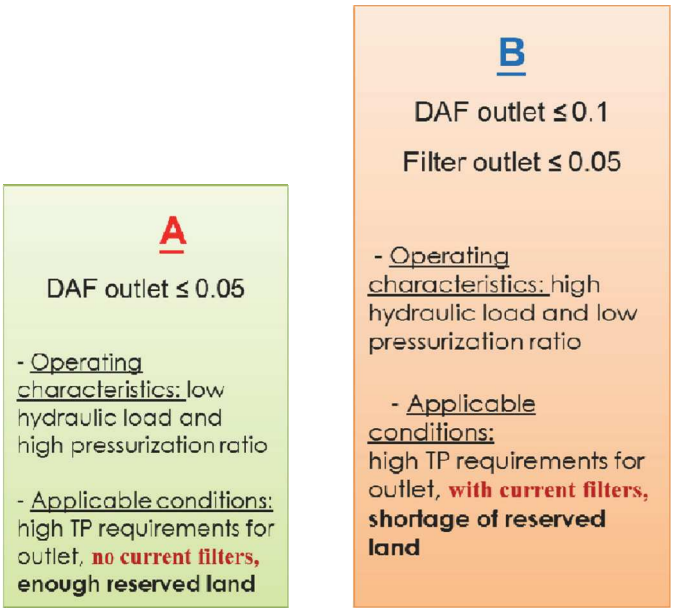


Figure 8

When the hydraulic load is 7 m/h and the recycle ratio ≥40 %, DAF outlet TP ≤0.05 mg/l.

When the hydraulic load is 15 m/h and the recycle ratio ≥25 %, DAF outlet TP ≤0.1 mg/l and sand filter outlet SS ≤0.05 mg/l.