Water Knight is a participant in BioBizzHub

VoDCa

Water Knight

Wastewater treatment process intensification through high performance vortex cavitation

Description: VoDCa Is an advanced oxidation reactor that harnesses power of cavitation. Cavitation is a physical phenomenon involving bubble formation, growth and adiabatic collapse, with the consequent generation of intense pressure and temperature (~1000 atm, ~5,000 K). These conditions lead to the formation of hydroxyl radicals (OH•) which are extremely reactive oxidising agents that can decompose pollutants. In wastewater treatment, cavitation induced degradation/mineralization of organic carbon reduces COD, ammoniacal nitrogen, colour and other contaminants and also increases biogas yield.

VoDCa's patented, CFD-optimised design, comprising a tangential inlet and cylindrical axial outlet connected by a disc shaped chamber, imparts and conserves angular momentum of fluid through the process. It creates a sufficient pressure drop to produce cavities/micro-bubbles which are collapsed in a controlled manner downstream of the device.

Application: VoDCa can be retrofitted into municipal and industrial wastewater treatment applications with complex effluents. Effluent complexity is mainly attributed to a variety of pollutant types and a high probability of refractory pollutants that are difficult to remove with conventional physical/chemical/biological processes. A VoDCa retrofit can offer a variety of value propositions, such as COD/ammonia/colour reduction, increase in biodegradability (BOD/COD ratio), selective degradation of refractive pollutant(s) and higher biogas yield. VoDCa can also be used for distributed water treatment (close to the effluent source).

Unique Selling Point: Hydrodynamic cavitation technology is not new but has not yet found a foothold in the market due to operational bottlenecks. Conventional venturi or orifice designs use linear flow conditions and a restriction of ~5 % total pipe area. They suffer from erosion of venturi/orifice and clogging. The VoDCa design: exploits vortex flow conditions wherein cavitation can be created without a restriction; ensures conservation of angular momentum, producing cavitation at relatively lower pressure drop (1.5 – 2 bar) compared to venturi/orifice systems (3 - 8

bar); is free from clogging and erosion as cavities are produced without a restriction and are contained within the vortex core away from the pipe walls.

Costs: VoDCa does not require any maintenance or consumables. Also, it becomes more OpEx efficient at higher capacities as the efficiency of centrifugal pumps increases at high flows. VoDCa is priced by application, depending on treatment objective, degree of contamination, etc. The cost is a combination of capital project cost and an agreed payback period, typically 24 months.

Financial Benefits: In addition to reduced OpEx, a VoDCa retrofit offers higher throughput by effectively handling load fluctuations and could increase plant throughput thus avoiding capital expansion costs.

Stage of Development and Two Case Studies: Currently, there are total 9 successful full-scale VoDCa installations (ranging from 20 - 50 m^3/hr) at industrial WWTPs and across the running Anaerobic Digesters.

In 2017, a 50m3/hr VoDCa system was procured to treat very high COD reactor wash effluent coming from an industrial plant. VoDCa significantly reduced water usage in dilution of the effluent fed to existing treatment processes. A 35-55% COD reduction was achieved. The customer has ordered more, higher capacity, VoDCa systems for use at different WWTP.

In 2017, a 40m3/hr VoDCa system was deployed in molasses based distillery. VoDCa was retrofitted in the feed of vinasse going to Anaerobic Digester. A 15% boost in biogas was observed. This 15% increase resulted in 6 m3 of extra biogas per m3 of feed. This is of the order of 1 Euro/m3 extra gain by spending less than 2 cents per m3.

Technical/Commercial Risk: Turndown capacity is usually rated below 20% of design capacity. When this window of operation is too narrow a bypass line across the main VoDCa installation, leading to a second VoDCa process that is rated for a lower capacity, can be used.

Introductory video : https://vimeo.com/270941934

Address: Agora 4, 8934 CJ, Leeuwarden, The Netherlands

Website: http://waterknight.com/