

Types of Activated Sludge Processes

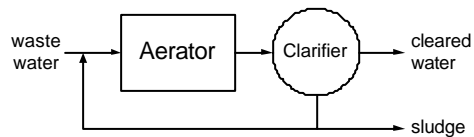
by Phillip Kern

History

- around 1850 most common practise of waste water treatment was landspraying
 - 1880-1900 tests to blow air through the waste water
→ aeration studies (1893 Mather & Platt, 1897 Fowler, 1905 Henderson)
 - 1912 first fill-and-draw – reactors, remaining sludge was disposed (Clark & Gage)
 - short time later sludge was reused (Fowler)
→ “Principle of sludge recycle”
 - 1914 this was described as “activated sludge process” (Adern & Locket)
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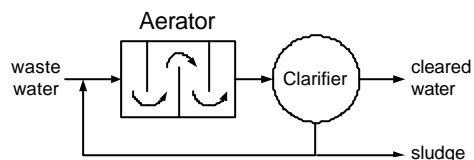
Conventional completely mixed process

- simplest layout for activated sludge processes
- first used in larger scale (with fill-and-draw – procedure)



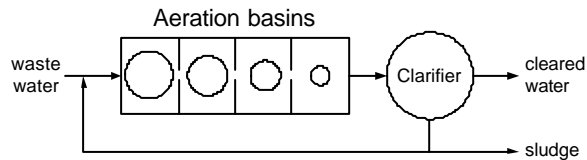
plug flow design

- 2nd basic layout
- water/sludge – mixture is moving constantly through an aeration tank
- along the flow is a gradient in substrate concentration and oxygen demand



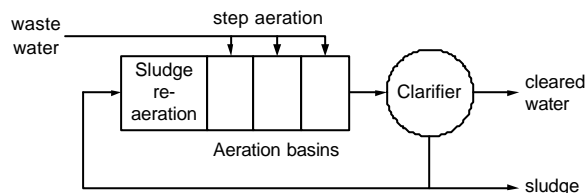
tapered aeration

- improvements concerning the oxygen requirement
- O_2 demand decreases during the process
→ supply of O_2 was adjusted (Kessl er 1936)
- permits power saving



step aeration/step loading

- improvements concerning the oxygen requirement
- try to keep the O_2 demand uniform by adding the waste water stepwise (Goul d 1942)
- produces well settling sludge



modified aeration process

- 1943 by Setter & Edwards
- keeping a low level of suspended solids (0.3 – 0.6g/l)
- aeration periods of 1.5 to 2 hours

→ BOD & suspended solids removals ~ 65 to 75%
→ produce compact sludges that are readily digestible
→ minimum of aeration/oxygen

→ compact intermediate treatment system

Kraus process

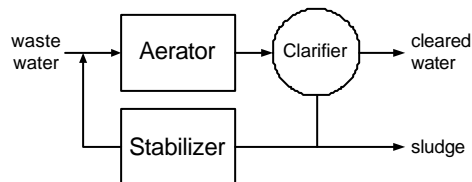
- 1950 by Kraus
- aeration of digester overflow, digester sludge & return sludge in separate tank
 - highly nitrified sludge, low volatile solids, good settling properties
- adding this sludge to the return sludge

→ ability to control sludge bulking

→ increase volumetric loading rate (B_V) from max. $0.6\text{kg/m}^3\text{d}$ to $1.7 - 3.0\text{kg/m}^3\text{d}$

biosorption process/contact stabilization

- by UI rich(1951) and Smith(1957)
- re-aerated return sludge is mixed with waste water for ca. 30min at high aeration and loading rates
- organics are adsorbed & metabolized during aeration
- maximum exploitation of adsorptive power of activated sludge



conclusion

aspects for Activated sludge processes:

- layout
- loading rate
- aeration system

today:

- activated sludge processes are not longer only focused on BOD-removal
- include nitrification, denitrification and phosphorus removal