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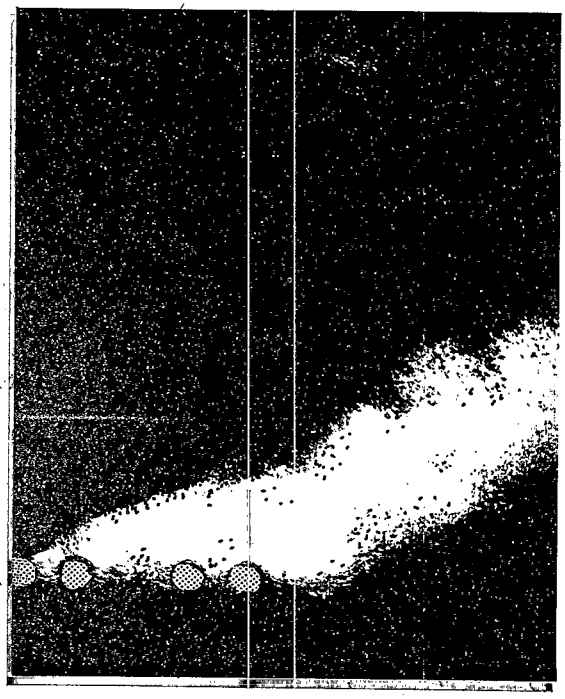
An Emerging Technology

Counter-current Aeration

A Promising Process Modification



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Countercurrent Aeration - A Promising Process Modifica

Cost Consciousness

Protecting the environment and meeting required wastewater discharge standards is becoming an increasingly costly undertaking for communities. New wastewater treatment plants are necessary to meet the demands of community growth and to replace old or inadequate plants, but new treatment facilities can be very expensive. In addition to major capital investment in equipment and construction, the community must pay the operation (power, chemicals, labor, sludge disposal) and maintenance costs year after year. The process selection decision, particularly for medium and small communities, will have implications on the municipal budget for the life of the plant and may even determine whether the project is to be built at all.

Therefore, the consulting engineer, the public utility, and the funding/regulatory agency must investigate innovative technologies that may make treatment plants less expensive and more efficient. Some interesting, emerging technologies are variations or modifications of standard wastewater treatment techniques. Countercurrent aeration is just such a technology. It is a modification of the aeration system of the extended aeration activated sludge process.

This fact sheet presents a capsule summary of the countercurrent aeration process to potential users and to those professionals who evaluate, recommend, and implement treatment process alternatives.

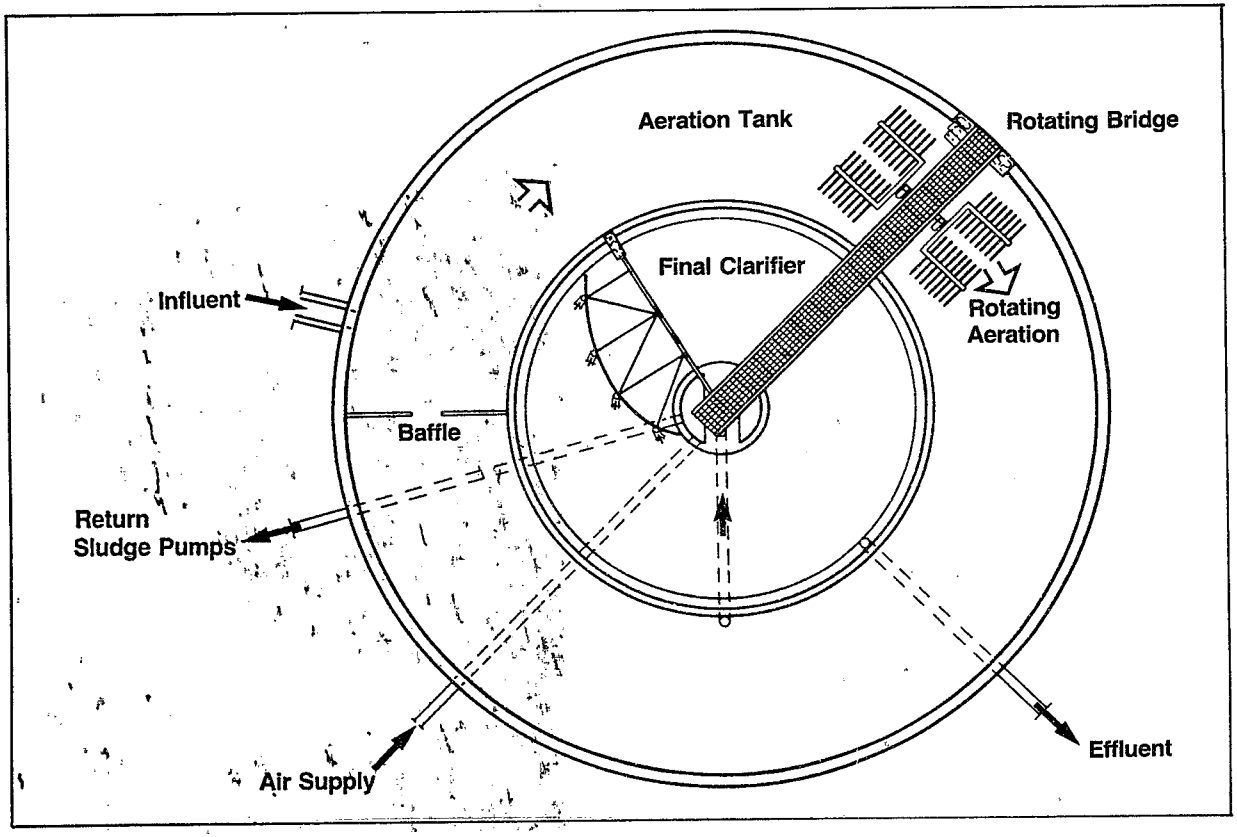

Figure 1 Process Plan View

Description
Countercurrent aeration is based on research performed in the Netherlands in the 1960s and developed into a full-scale treatment process by the Schreiber Corporation in West Germany.

Aeration of the activated sludge is accomplished by a diffuser grid suspended from a rotating bridge which travels around the circular tank at an approximate rate of 1 rpm. The term "countercurrent" refers to the aeration system movement in relation to the biomass. This is the opposite of the fixed aeration situation found in other diffused air processes (where the biomass moves relative to the diffusers).

Process design of the countercurrent aeration plant is similar to that used in conventional extended aeration. Process layout for facilities up to approximately 1.25 MGD is usually economical using tankage as shown in Figure 1. This figure illustrates one of the six configurations available in the United States from the Schreiber Corporation. Alternate tank arrangements can provide for separate sludge thickening and digestion, as well as denitrification.

Aeration Considerations
The aeration devices used in the process are porous stone diffuser tubes which provide efficient oxygen transfer. However, the rotation of the diffuser system provides a horizontal component to the bubble path. The longer bubble path, shown in Figure 2, can result in higher oxygen transfer than conventional systems.

Further process efficiency results from the reduced oxygen requirement for mixing; the bridge rotates at a rate sufficient to provide mixing before settling occurs. The aeration system can usually be designed for oxygen transfer requirements, whereas higher mixing air requirements might have governed for traditional extended aeration. The design also allows for fewer diffusors and less air piping than conventional systems.

Present Use
Over 500 countercurrent facilities are operational worldwide but only ten are in the United States (Table 1). However, several more are under construction in this country. Since nearly all of the

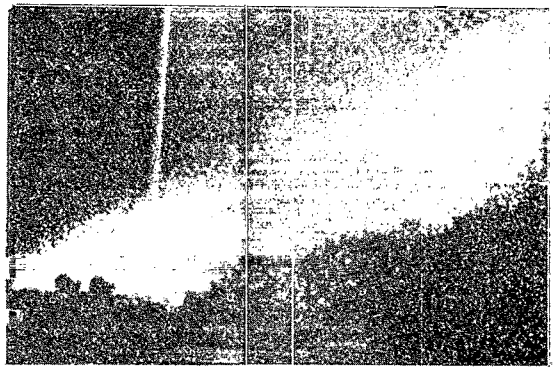

Figure 2 Bubble Dispersion Pattern

plants are new, most of them are operating well under capacity with resulting excellent performance. At capacity, the process is expected to perform at least as well as conventional extended aeration activated sludge with lower energy costs.

Capital Costs
A comparison of typical construction costs for countercurrent facilities with certain other activated sludge processes is shown on Figure 3. The costs can be affected by, among other things, site conditions, industrial waste contributions, and final effluent quality requirements.

Location Operating	Size (MGD)
Fredericksburg, PA*	0.5
Grand Island, NY	0.2
Carlisle, PA	1.2
Cocoa, FL	3.0
Mahanoy City, PA	1.0
Timber Pines, FL	0.2
Loudon, TN	7.0
Claiborne County, TN	0.7
Hampden Township, PA	4.0
Tuskegee, AL	2.0

*Industrial system (poultry)

Table 1 United States Countercurrent Aeration Plants (January 1983)

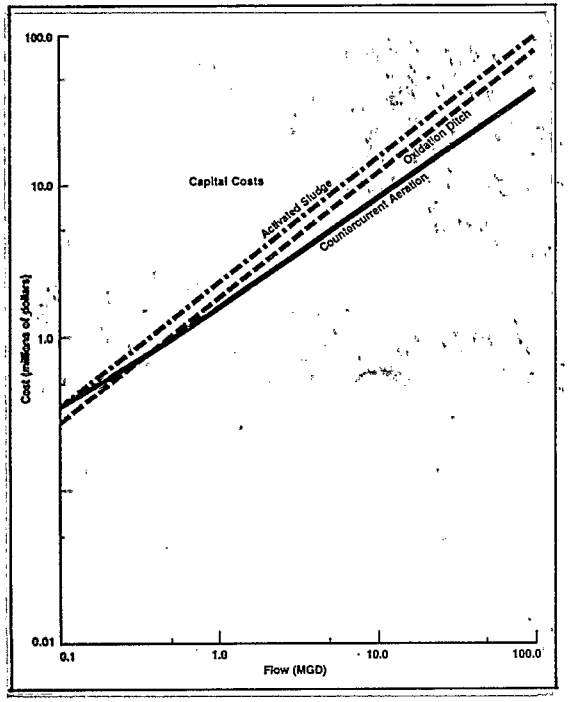

Figure 3 Cost Curves

	Oxygen Transfer* lb O_2/hp/hr	Power Use hp/MGD
Extended Aeration with Coarse Bubble Diffusers	3.0	83
Oxidation Ditch	3.4	73
Mechanical Aerators	3.6	69
Extended Aeration with Fine Bubble Diffusers	5.0	49
Countercurrent Aeration	6.0	41

*with clean water

Table 2 Power Use Comparison

Annual Costs

Operation and maintenance costs will be similar to other extended aeration processes with the exception of power. Table 2 shows the dramatic energy savings that can be achieved by using the countercurrent aeration process (which also uses the fine bubble diffusers).

Limitations

- Generally not cost-competitive for plant sizes under 150,000 gpd.

Observed Advantages

- Significant power savings over other activated sludge processes.
- Requires less land than some other extended aeration processes (e.g., oxidation ditch).

Process Considerations

- Concentric clarifier/aeration tanks possible up to 1.25 mgd.
- Careful tank construction and rotating equipment placement required.
- Standard design may require some additions or modifications for maximum operation flexibility and safety.