Chapter I

INTRODUCTION

1.1 History of Sludge Blanket Clarifier

Sludge blanket clarifiers for water treatment and softening have been known since the end of the 18th century. In water treatment installations they have a function similar to sedimentation basins.

The Dortmund tank, the first large-scale application of the process was developed about 1880 by Mueller - Nahnsen and Kuiebuchler of Dortmund in the Ruhr (PRAGER 1950). Originally it consisted in a vertical tank with a large cone-shaped or hopper-shaped bottom. This tank was equipped for the suspension and use of a sludge blanket, by means of a device for control, downward, pulsating introduction of incoming liquid.

The most important, early sludge blanket clarifier was covered by a patent awarded in 1892 to Archbutt and Deeley. It used two distinct but intercommunicating compartments, one for mixing and another for clarification. The process was called Accelerated Precipitation. The inventors of this process are, perhaps, better known as the originators of recarbonation. The precipitation of hardness with Acceleration by sludge was known in France as well as in England, about 1900.

Declercq improved the recirculating process by using a sequence of mixing operations. He preferred to recirculate and suspend a light or medium sludge, rather than the heaviest particles, because he found that beyond a certain diameter the efficiency of the particles appears to diminish. He disclosed that recirculation may be adjusted to provide a ratio of old to new materials as low as 5:1 up to 100:1, he stated these ration on a basis of solids. In 1909 it was further developed by Lamy. Lamy's tank can best be described as an Accelator with airlift actuated sludge recirculation (PRAGER 1950).

The first of the modern sludge blanket clarifiers or solids contact basins was developed by Charles H. Spaulding in 1938 at Springfield, Ill. (HOPKINS & BEAN 1966). The process was called "Precipitator". A precipitator is a combination of mixing, coagulation, and settling tank designed to bring the unstable lime-treated water into equilibrium quickly, by retaining the previously precipitated carbonates and the hydroxides in suspended contact with the water flowing through. The velocity of flow of water through this equipment is so controlled that the precipitates are kept in suspension up to a level where the water, passing upward through them, leaves them sharply behind and flows from the top of the equipment as a clear liquid. In the filtering zone, sludge blanket, the particles remain uniformly speed from top to bottom. This is not only theoretically correct, but has been proved by repeated samples drawn from various sections of the clarifier.

Today as in Europe and U.S.A., besides a large number of industries, are reported to be using the upflow solids contact tank with single units ranging from 10,000 gal per day to 35 mill gal per day. Several U.S. and international equipment companies market such units under various names:

ACCELATOR	(Infilco Co.)

PRECIPITATOR	(Permutit Co.)
HYDROTREATOR	(Dorr - Oliver)
REACTIVATOR	(Graver Water Conditioning Co.)
PULSATOR	(Degremont)
CLARIFLOW	(Walker Process Equipment Inc.)
LIQUON	(Cochrane Corp.)
Flocsettler	(American Well Works)

Upflow clarifiers have proven to be efficient in some instances and in other cases have shown themselves prone to upset. Standard sedimentation theory applied to an ideal horizontal flow settling tank handling discrete (nonflocculent) particles shows that all particles having a settling velocity equal to or greater than the velocity equivalent to the surface loading of the tank will be removed. In an upflow tank handling discrete solids, all particles whose settling velocity is less than the surface overflow velocity will escape from the tank. Based on this reasoning it seems horizontal flow tanks would always prove to be more efficient. However most actual particles encountered in water and wastewater treatment are flocculent and this characteristic alters tank performance in very significant ways, particularly in upflow units.

The horizontal flow clarifier must be provided with sufficient preflocculation facilities and should be designed so that the surface loading (flow per unit surface area) is numerically equal to the discrete settling velocity of the smallest particle size of the floc to be removed. In comparison, the vertical flow floc blanket system would theoretically require a lower surface loading (upflow velocity) to separate the same size of particle as the horizontal unit, due to the lower settling velocity resulting from the interference of flocs in bulk.

The advantage of clarifiers is their relatively short retention period (between 1 hr. and 2 hr.), lower capital investment (about 15% less than sedimentation basins), and better clarifying ability. However they require closer supervision and are dependent more on the accuracy of the chemical dose (TESARIK 1967).

1.2 Definition of Sludge

Sludge defines the solids particles which have settled from water undergoing treatment or are in the process of settling whether they be products of chemical reactions or coagulated turbidity or a combination of both. In plain sedimentation, these sludges are simply those materials that were originally in suspension.

1.3 Purpose of the Research

The study was conducted to determine the effect of the upflow velocity, slurry strength, and sludge blanket depth on the performance of a sludge blanket clarifier.

1.4 Scope of the Investigation

The performance of a sludge blanket clarifier using alum as chemical coagulant was investigated. The following criteria are included:

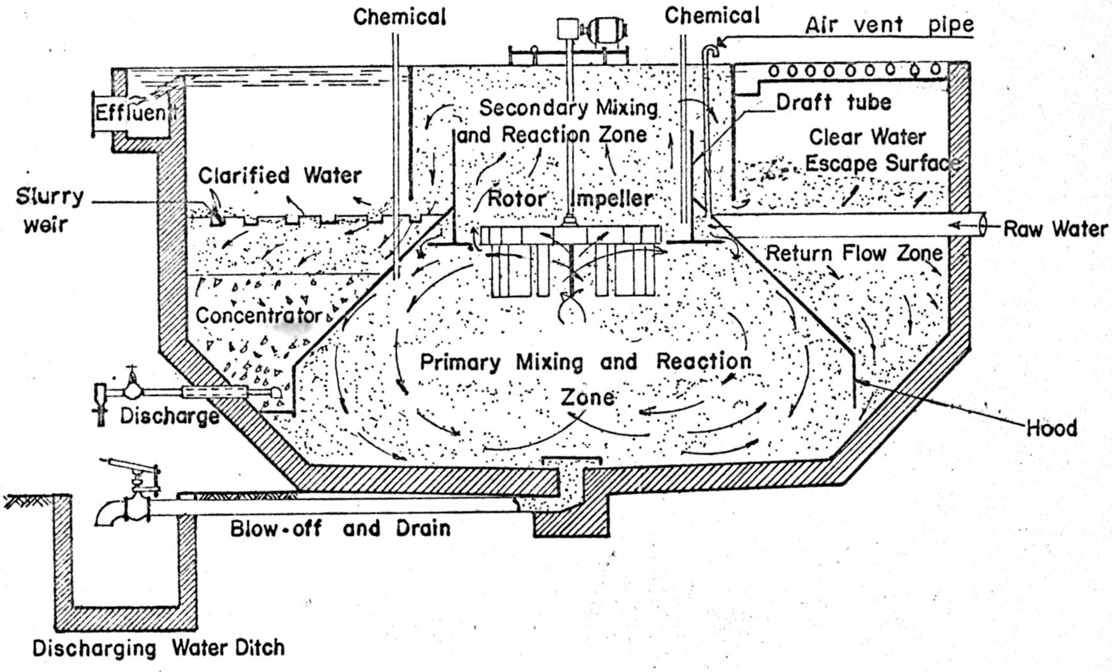
(a) Speed of rotor

(b) Rate of sludge blowoff.

It was not intended that the study provide complete answer to the performance of sludge blanket clarifier for all water treatment plants.

1.5 Plant Descriptions

The Accelator clarifier which forms a part of Thonburi Water Treatment Plant with nominal capacity of 160,000 m^3/day was used in this investigations. The plant is operated on a 24 hour per day basis throughout the year. Built in 1964, it incorporates some of the latest instrumentation and control equipment. Raw water is collected in the inlet tower and flow by gravity to 4 accelator clarifiers 26.20 metres (86 ft.) in diameter. A simplified accelator clarifier is shown in Fig. 1.1.



The Accelator consists essentially of a basin in which is contained:

1. A raw water inlet.
2. A primary mixing and reaction zone.
3. Two concentric draft tubes which form the secondary mixing and reaction zone.
4. A rotor-impeller for mixing.
5. An effluent launder system.
6. Concentrators to accumulate and remove excess slurry.

Fig. 1.1 A Simplified Accelator Clarifier.