Water Treatment Plant Design
Lecture-4
Lamella Seperators

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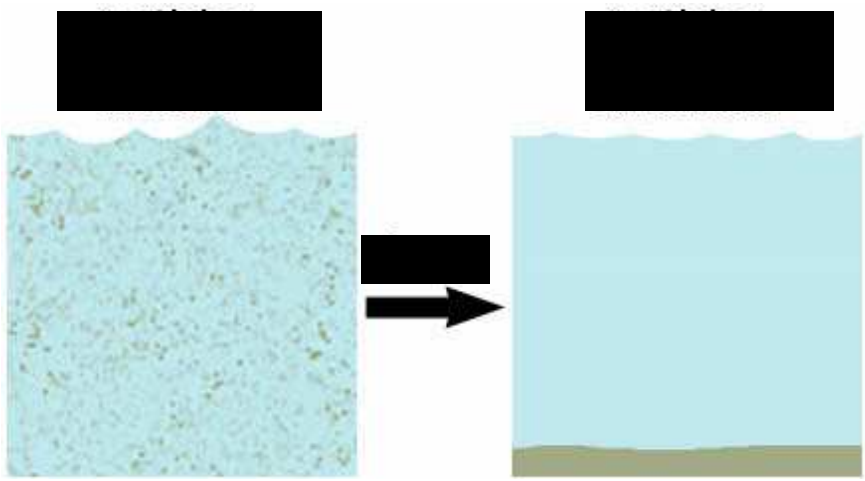
Çökeltme ve Lamel Sistemi

Çökeltme



Stoke's Law:

- This equation relates the terminal settling or rise velocity of a smooth, rigid sphere in a viscous fluid of known density and viscosity to the diameter of the sphere

- $V = (2gr^2)(d1-d2)/9\mu$

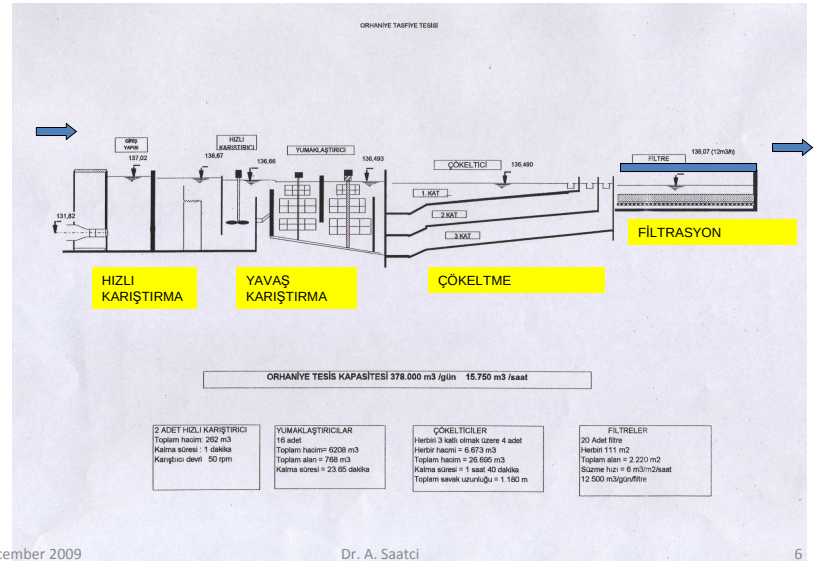
where
V = velocity of rise (cm sec^{-1}),
g = acceleration of gravity (cm sec^{-2}),
r = "equivalent" radius of particle (cm),
dl = density of particle (g cm^{-3}),
d2 = density of medium (g cm^{-3}), and
μ = viscosity of medium (dyne sec cm^{-2}).

Çökeltme

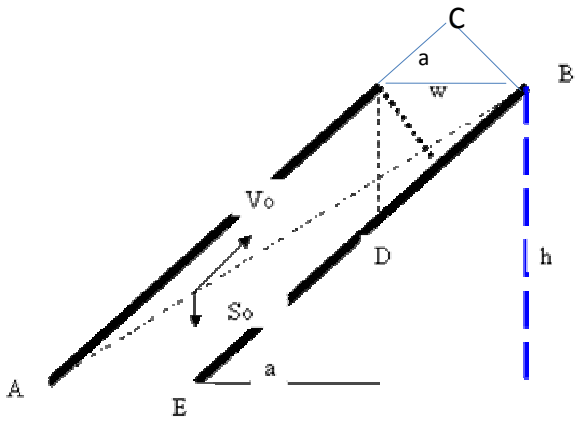
ÇÖKELTME TANKI YÜZEY YÜKLERİ

Yumak Tipi	Yumak Çökme Hızı, Vp, m/h	Boyutlandırma Hızı = Vp/2, m/h	Sıcaklık,C
Alum, 10C	1.63	0.82	10
Alum, 20 C	2.71	1.35	20
Alumla renk giderimi, kırılgan flok	2.2-5.0	1.1-2.5	20
Alumla Alg Giderimi	3.7-5.4	1.8-2.7	20
Alumla Bulanıklıkgiderimi, kuvvetli flok	4.4-6.3	2.2-3.2	20
Avrupa Standartı	4.4-9.8	2.2-5.0	20

3 Katlı Çökeltme Tankları



Lamel Teorisi

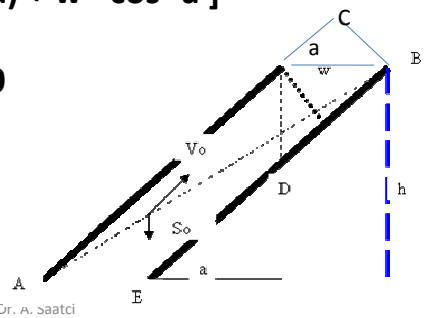


AC = h/sin(a) + w/tan (a) = Vo*T
CD = w/cos (a) = So* T

Lamel Teorisi

- **AC = h/sin(a) + w/tan (a) = Vo*T**
- **CD = w/cos (a) = So* T**
- **So/Vo = w sin (a) / [h*cos (a) + w cos ^{2}a]**
- **Vo=(Q/A)/sin (a)**
- **So = Q/A * w/[h*cos (a) + w* cos ^{2}a]**

- **W=0.1 m, h= 1m, a= 60**
- **So= 0.19* Q/A**
- **Q/A = 5.25 * So**
- **Q/A = K * So**



Different Lamella Configurations

Degramont (Water Treatment HB, p. 170), gives:

$U1/Uo = S_H/(nS_L \cos \alpha)$ ----------1

values for different configuratons of lamella plates:

Note that U1/Uo is the same as (Q/A)/So of the above derivation

S_H = is the horizontal surface area = A = B*W/sin α

İn which W is the lamella width.

S_L = is the lamella area = B* L

in which L is the lamella length.

Inserting the above values in eqn 1:

(Q/A)/So = K' = h/sin α * cos α / (w*sin α) = h/w cos α which is the first term the K value derived above.

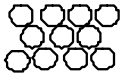
Different Lamella Configurations and K values

Shape

K= 6.4

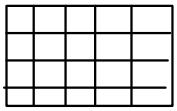
Shape

K= 7.4



Shape:

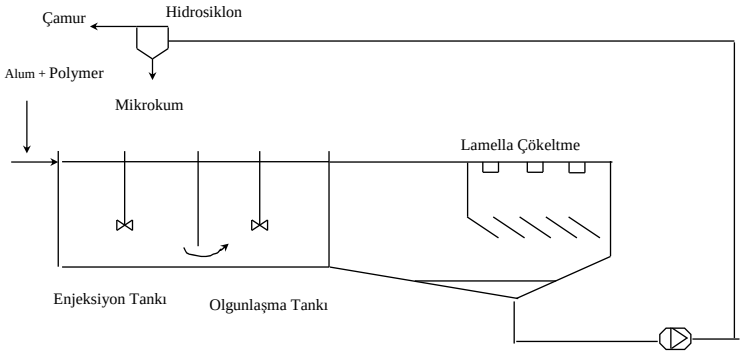
K= 8.1



Shape:

K= 10.8

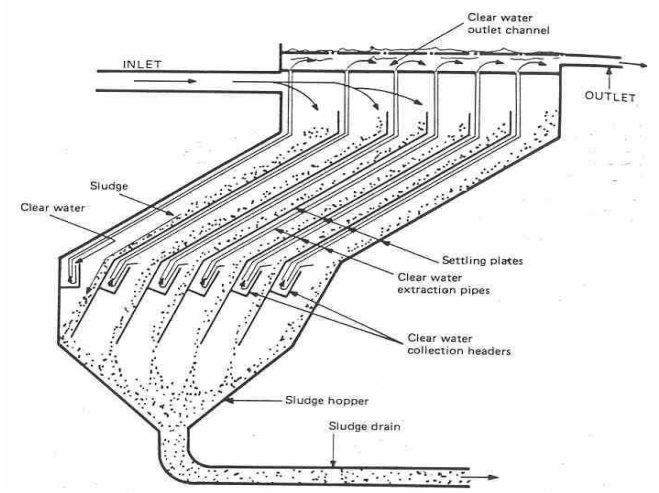
Mikrokum Kullanılarak Hızlandırılmış Yumaklaşma (Cyclofloc, Aktiflo)

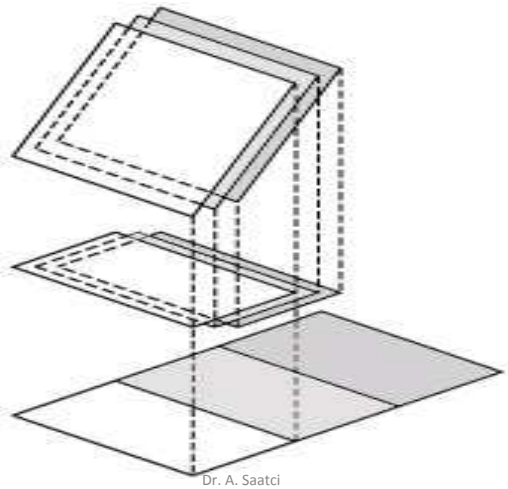


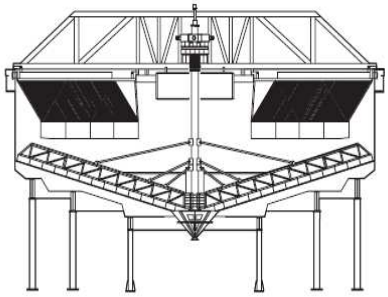
Aktifilo prosesi (Muradiye SAT - Ömerli)

Kırıkkale SAT- Lameller

Kırıkkale SAT: Lameller

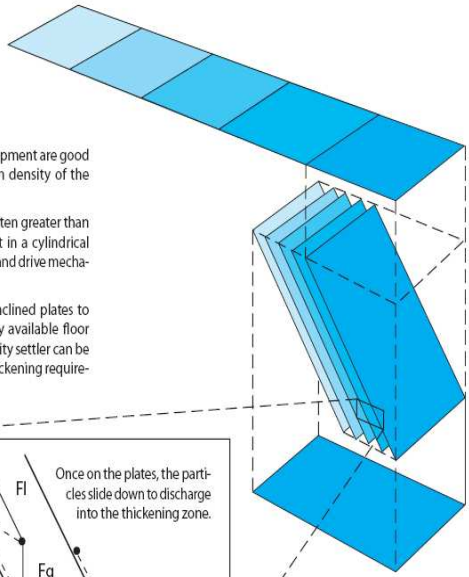

Clear water
outlet channel
INLET
OUTLET
Sludge
Clear water
Settling plates
Clear water
extraction pipes
Clear water
collection headers
Sludge hopper
Sludge drain





Heavy duty IPS with radially placed lamella packs.

Prefabricated lamella pack.

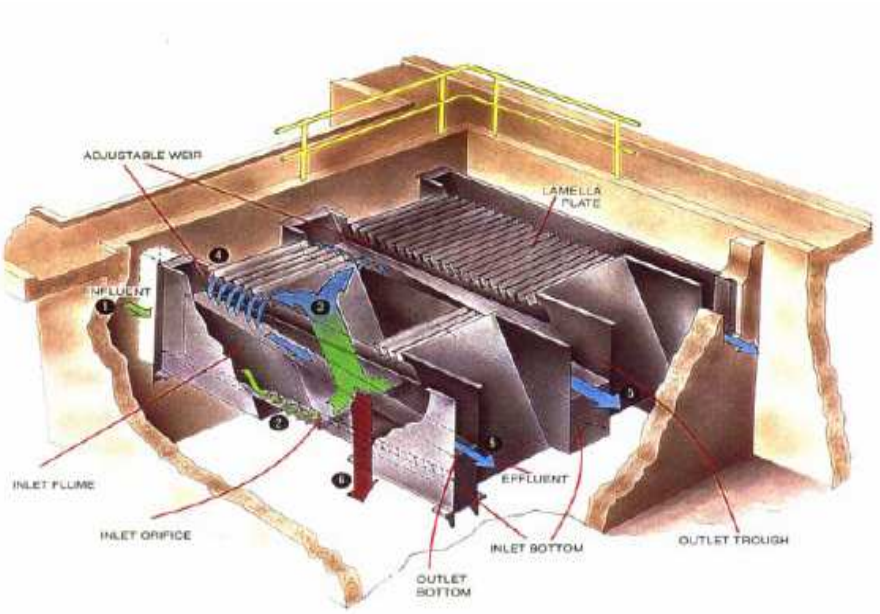


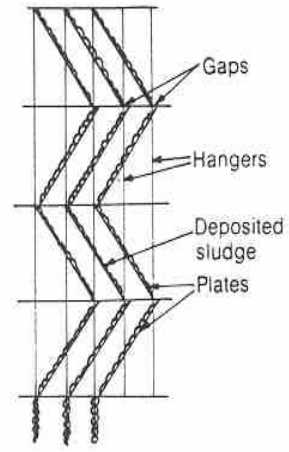
The Lamella Principle

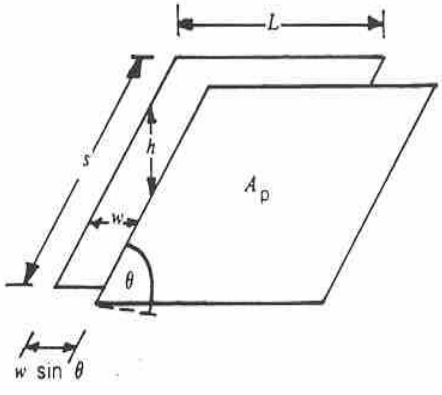
The two basic criteria for gravity settling equipment are good clarity of the overflow liquid and maximum density of the underflow solids discharge.

The area required to clarify a suspension is often greater than that needed for thickening. This means that in a cylindrical thickening tank, the lower section with rakes and drive mechanism can be oversized.

The lamella principle uses several parallel inclined plates to maximise the available settling area for any available floor area. In this way, the size and cost of the gravity settler can be minimised by matching the clarifying and thickening requirements more closely.


ADJUSTABLE WEIR
LAMELLA PLATE
INFLUENT
INLET FLUME
INLET ORIFICE
EFFLUENT
INLET BOTTOM
OUTLET TROUGH
OUTLET BOTTOM


Gaps
Hangers
Deposited sludge
Plates


L
s
h
A_p
w
θ
w sin θ

Lamella Plates in Wastewater Treatment

Design guidelines / Technical data

- **Incline of lamella plates ~60 degrees (to prevent clogging).**
- **Recommended distance between lamella plates 50 to 100 mm to prevent clogging. Distance also depends on pre-treatment.**
- **Recommended aeration rate: 0,05 m3/(m2.h)**
- **If air-flushing of lamellas is required, aeration grid should allow aeration rates of 10 - 20 m3/(m2.h)**
- **Hydraulic loading < 0,5 m3/(m2.h)**
- **Solids loading < 3 kg/(m2.h)**
- **Sludge volume loading (=solids loading * sludge volume index) < 500 l/(m2*h)**.
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Lamella Plates in Wastewater Treatment

Performance

- Separation degrees of 25% - 50% can be achieved during combined water flow
- An increase of the MLSS content from 3 - 3,5 to 6 g/l possible.
- Separation of up to 80% - 100% during dry weather conditions.

Operational stability and maintenance

Maintenance requirements are reported to be low. Special attention has to be paid to the construction of reactors, that are fitted with lamella settlers and the installation of the lamella themselves to prevent clogging.

Capital and operating cost

- Specific cost of 60 - 80 euro/m2 surface plate (120 - 160 euro/specific effective settling area at an incline of 60 degrees) for total surface areas > 300 m2, excluding assembly (these costs refer to a specific lamella unit).
- No indications yet with regard to additional operating cost for cleaning of the lamellas.
- Cost savings potential of more than 50% seems possible compared to conventional upgrading solution.