

III. Water Treatment

Topic III. 2. Coagulants and Flocculants.

Coagulation Processes: Kinds and Application

Coagulants

- ❑ Aluminium sulphate - $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$
- ❑ Iron sulphate - $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
- ❑ Iron chloride - FeCl_3

Flocculants

- ❑ Activated silicon acid (ASA) - Na_2SiO_3
- ❑ Polyacrylamid (PAA)
- ❑ Other synthetic polymers

Dozes of Coagulants and Flocculants

Doze of Coagulants - D_c

$$D_c = 4\sqrt{C} \text{ , mg/l}$$

where C is water colour grade, *grad* (Pt-Co scale)

Doze of the Alkalinity Regulation Reagent - D_A

$$D_A = k\left(\frac{D_c}{E} - A + 1\right) \text{ , mg/l}$$

where E is equivalent mass of the dry reagent, *mg-eq/l*

A - alkalinity, *mg-eq/l*

Dozes of Coagulants and Flocculants

Dozes of Coagulants

Suspended solids <i>mg/l</i>	Doze of coagulant <i>mg/l</i>
up to 100	25 - 35
101 - 200	30 - 45
201 - 400	40 - 60
401 - 600	45 - 70
601 - 800	55 - 80
801 - 1000	60 - 90
1001 - 1400	65 - 105
1401 - 1800	75 - 115
2801 - 2200	80 - 125
2201 - 2500	90 - 130

Dozes of Coagulants and Flocculants

Dozes of Flocculants

a) Before settlers or clarifiers

Suspended solids
mg/l

Dozes of flocculant PAA
mg/l

1000 - 500

1,0 - 0,2

500 - 100

0,5 - 0,25

100 - 10

0,8 - 0,4

10

2,0 - 1,0

b) Before high rate send filters

50

0,01 - 0,1

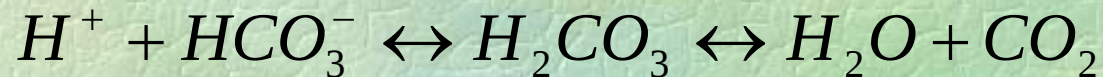
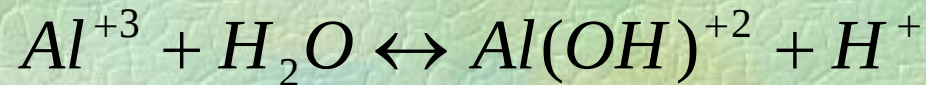
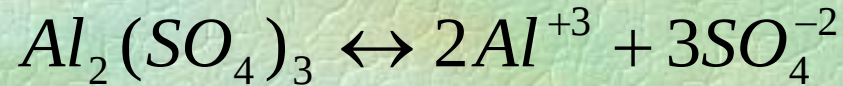
c) Before contact (send) clarifiers

150

0,2 - 0,6

Coagulation Processes

Hydrolysis and Flocc Formation



Technological Processes with Coagulation

- ❑ Diffuse coagulation (flocs, suspended in the water volume)
- ❑ Contact coagulation (on the pollutants suspended particles)
- ❑ Adsorption (on the sand particles)

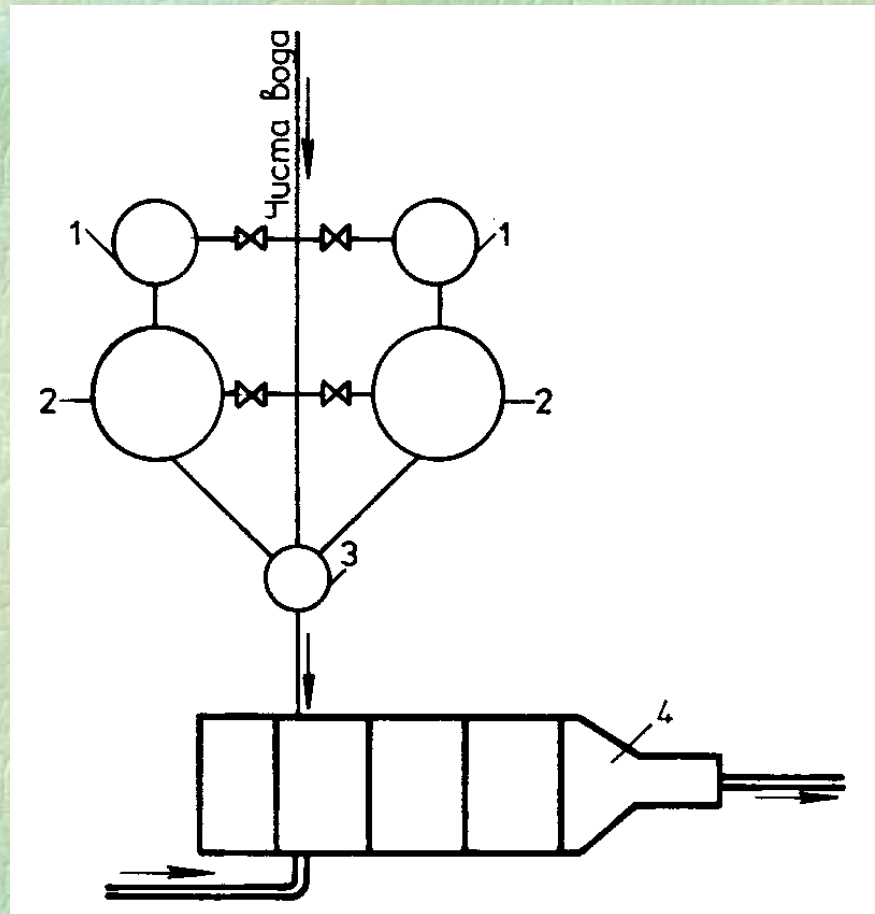
Technological Units with Coagulation

- ❑ Settlers
- ❑ High rate sand filters
- ❑ Contact (sand) clarifiers
- ❑ Upflow sludge blanket clarifiers

Reagents Management Units

- **For reagents keeping**
 - **As dry substances**
 - **As concentrated solutions**
- **For reagents solution preparing**
- **For reagents dozing**
 - **Dry reagents dozing**
 - **Reagents solutions dozing**
- **For reagents and water mixing**
 - **Eddy type**
 - **With baffles**
 - **With propellers**
 - **With aeration**

Reagents Management Units



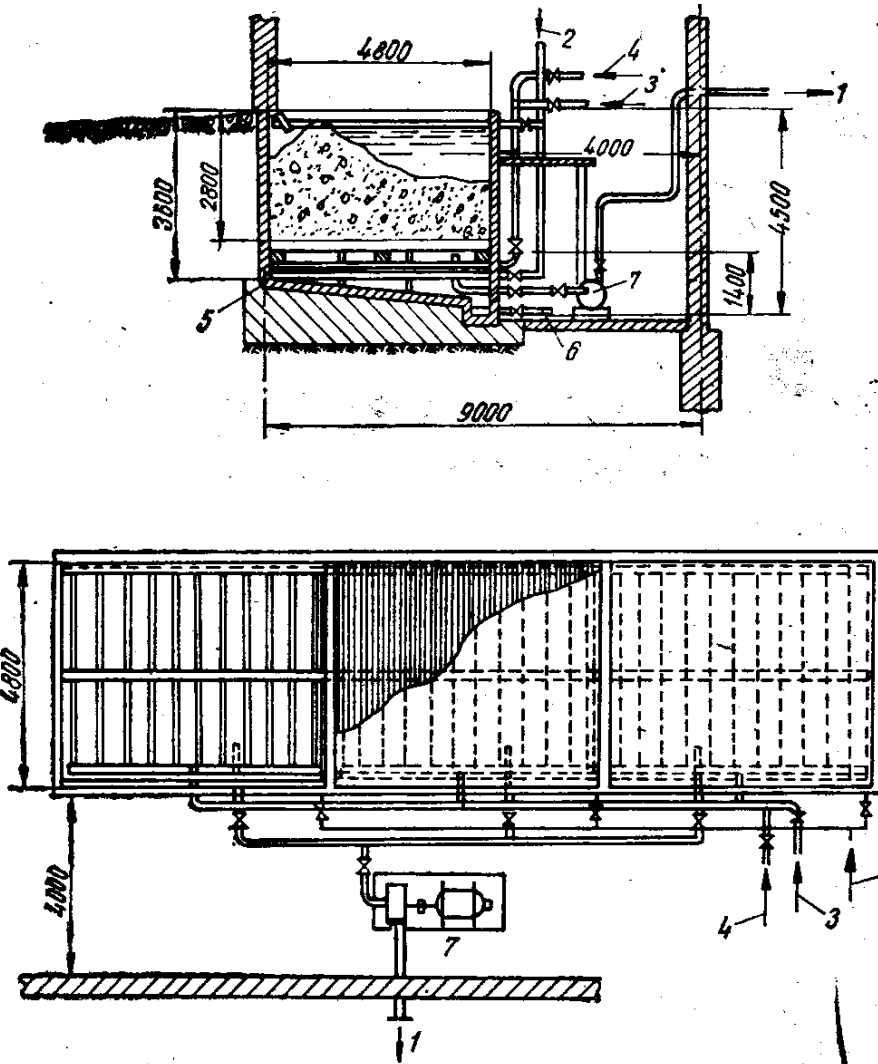
General Reagents Management Scheme

1 - vessels for concentrated reagents solution (for reagents keeping); 2 - Vessels for diluted (working) reagents solution; 3 - dosing facility; 4 - mixing chamber

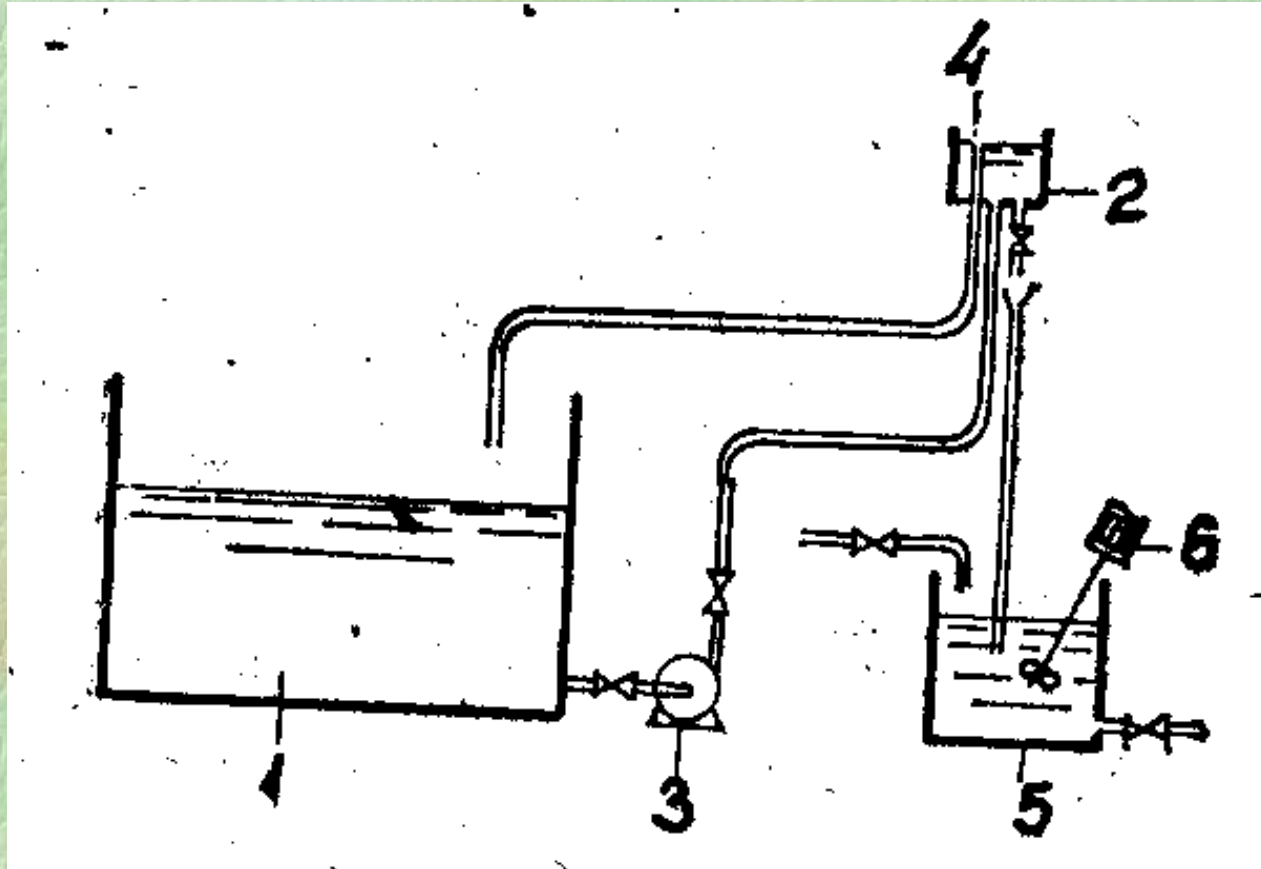
Reagents Management Units

Facility for Concentrated Reagent Solution Preparing and Keeping

- 1 - solution of aluminium sulphate
- 2 - air
- 3 - water
- 4 - steam
- 5 - washout water
- 6 - sediments (sludge)
- 7 - acid-proved pump



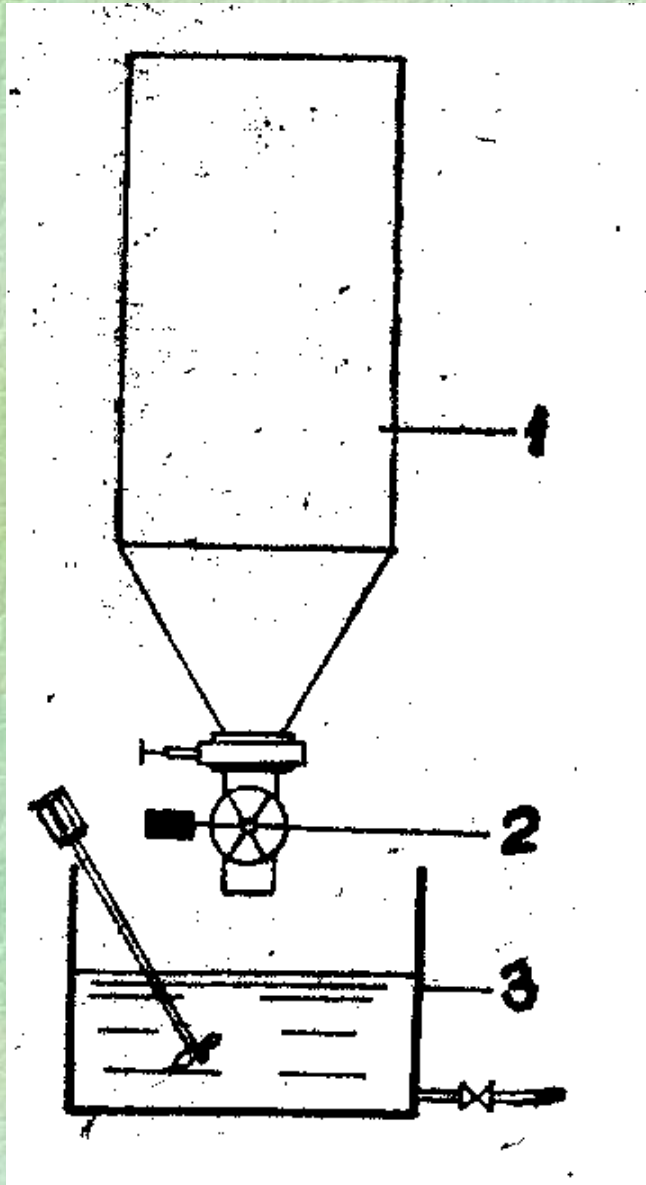
Reagents Management Units



Preparing of Diluted (Working) Reagent Solution from Concentrated Reagent Solution

1 - reservoir for concentrated reagent solution; 2 - dosing vessel; 3 - pump; 4 - overflow pipe;
5 - mixing chamber; 6 - propeller mixer

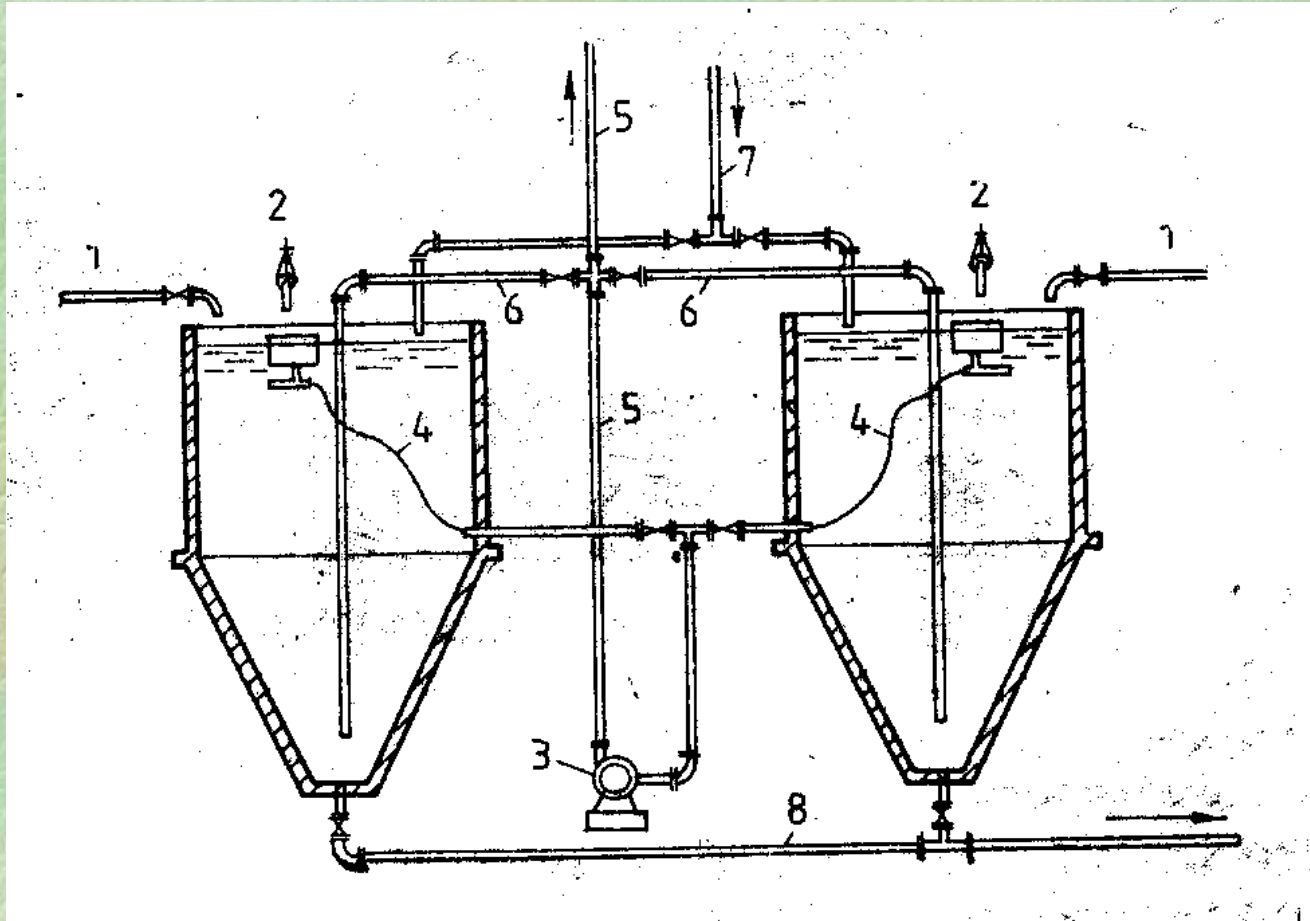
Reagents Management Units



Preparing of Diluted (Working) Reagent Solution from Dry Reagent (Powder)

- 1 - silo for reagent (powder) keeping
- 2 - dozing device
- 3 - reservoir for diluted reagent solution

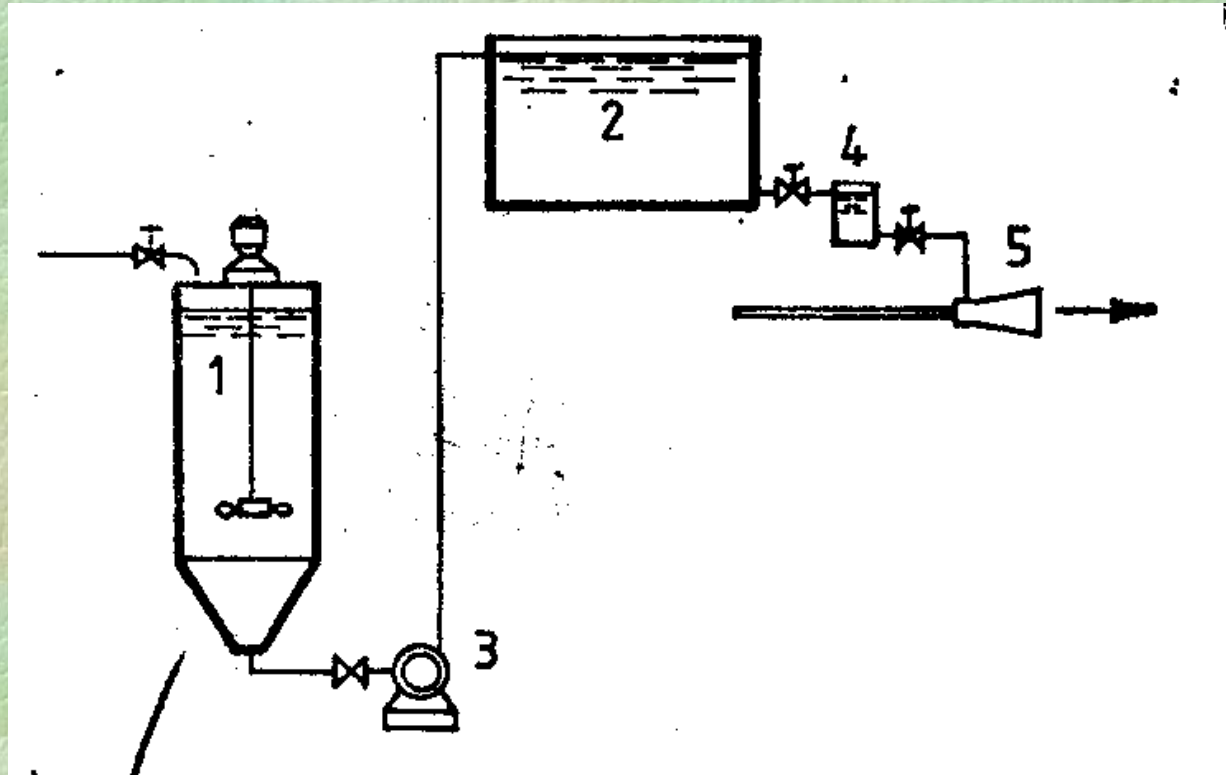
Reagents Management Units



Vessels for Diluted Lime Solution Preparing

- 1 - pipe delivering concentrated lime solution; 2 - delivering dilution water ; 3 - pump for mixing and solution transportation; 4 - flexible hoses; 5 - pipe to the dosing device;
6 - pipe for solution circulation (mixing); 7 - excess solution back-flow pipe; 8 - drainage¹¹ pipe

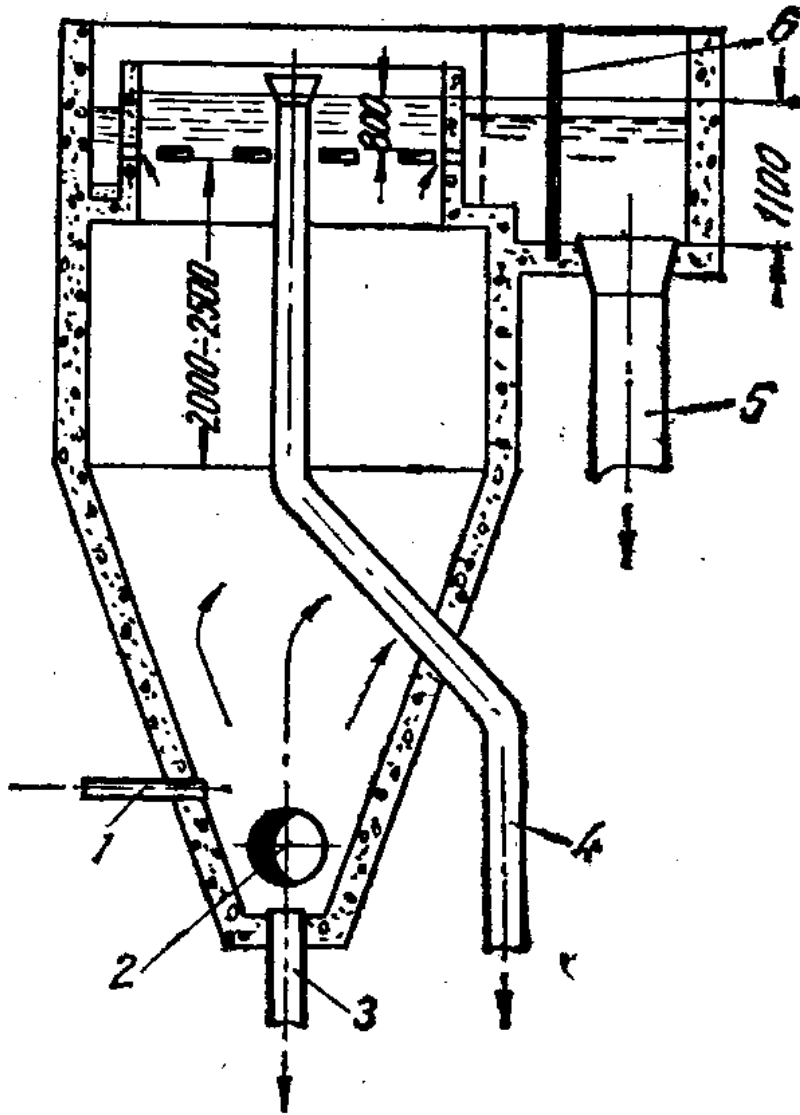
Reagents Management Units



Scheme of Facilities for Preparation of Polyacrylamid (PAA) solution

1 - vessel for PAA solution preparation; 2 - intermediate reservoir; 3 - pump; 4 - dosing device; 5 - mixing ejector

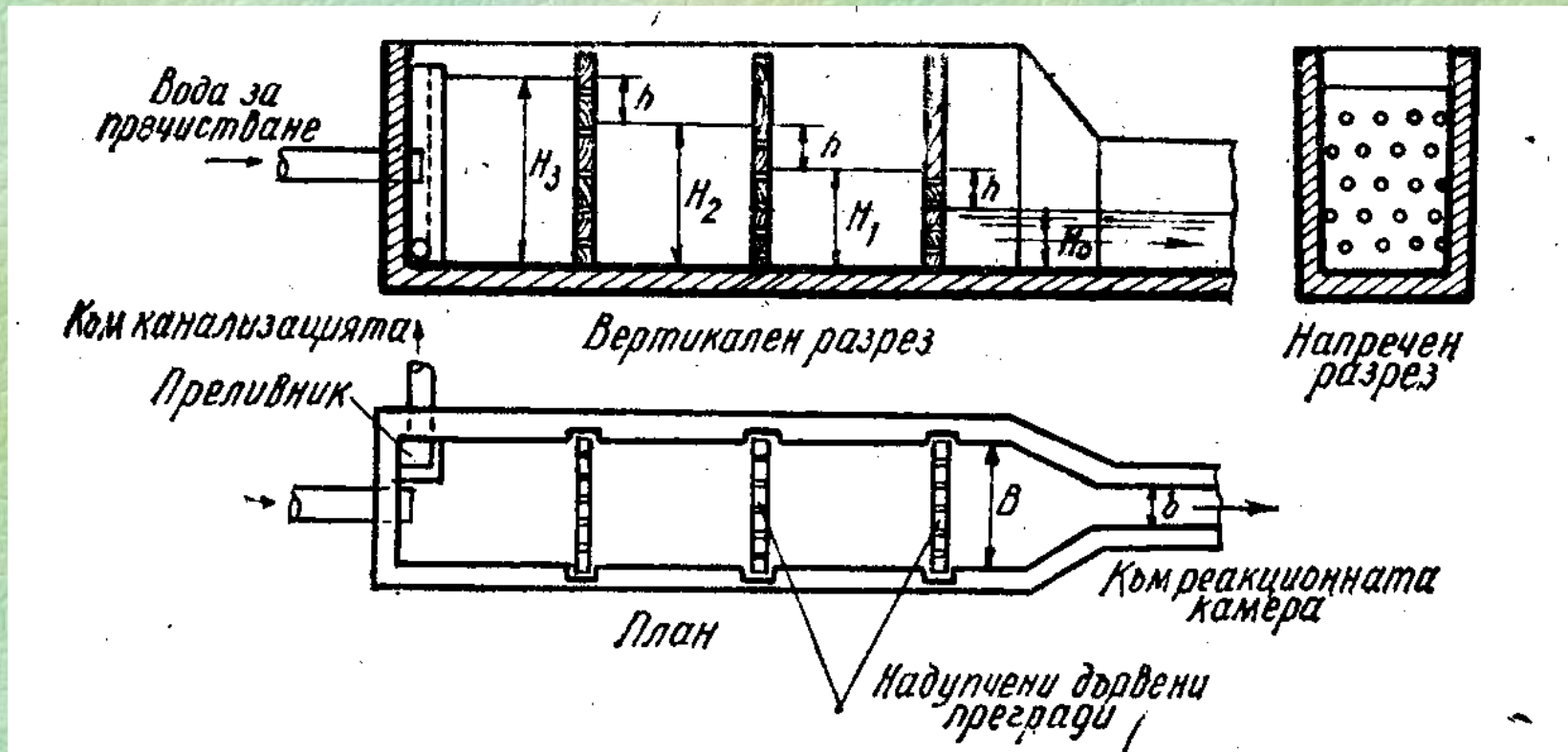
Reagents Management Units



Vertical Eddy Type Mixing Chamber

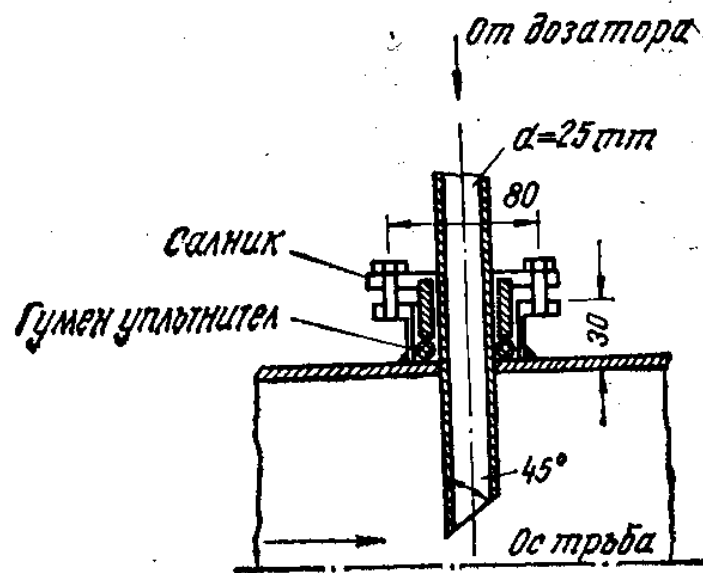
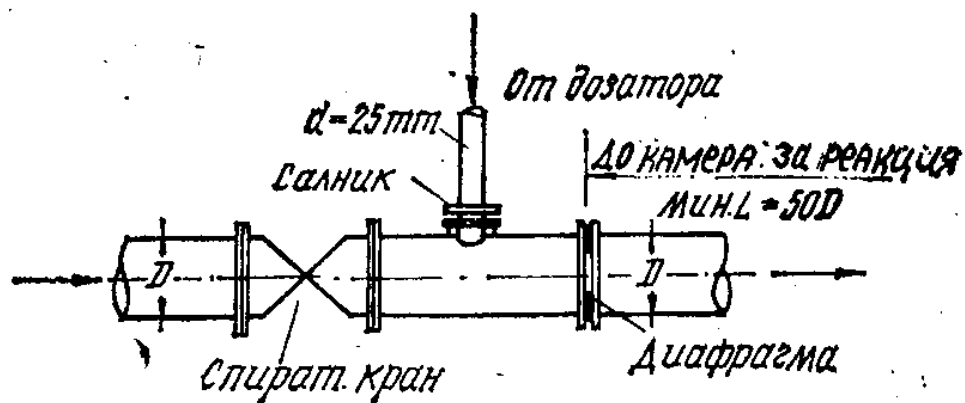
- 1 - reagent inflow pipe
- 2 - coarse water
- 3 - sludge withdrawing pipe;
- 4 - overflow pipe
- 5 - treated water feeding pipe
- 6 - rack

Reagents Management Units



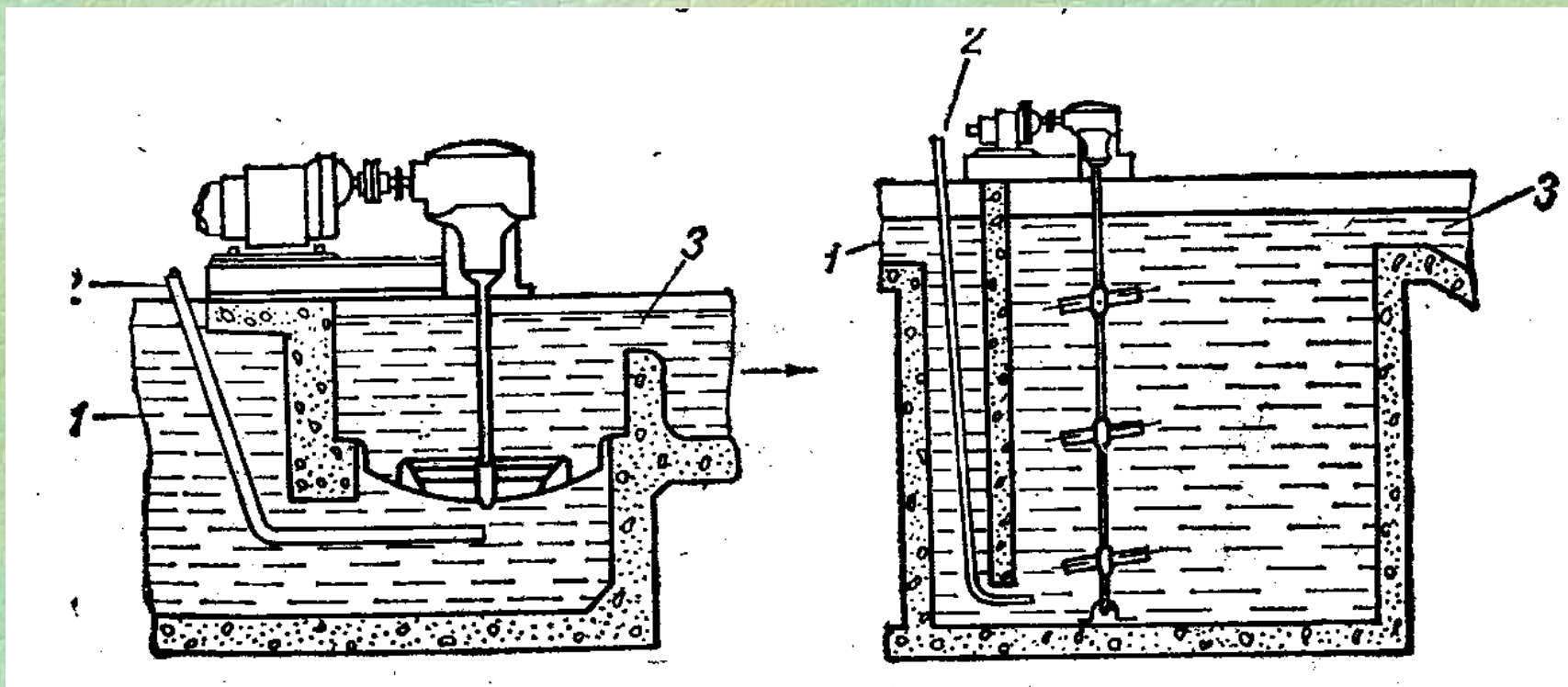
Mixing Chamber with Perforated Baffles

Reagents Management Units



Diaphragm Dozing Device

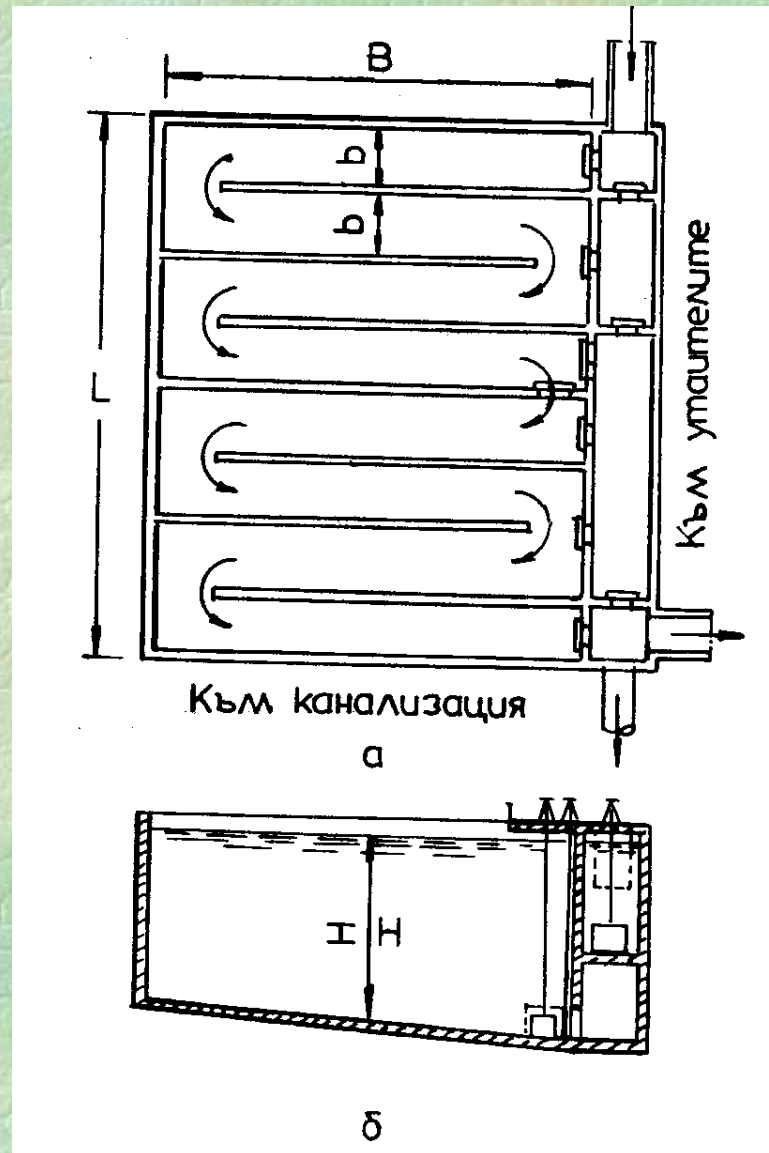
Reagents Management Units



Mixing Chamber with Mechanical Agitators

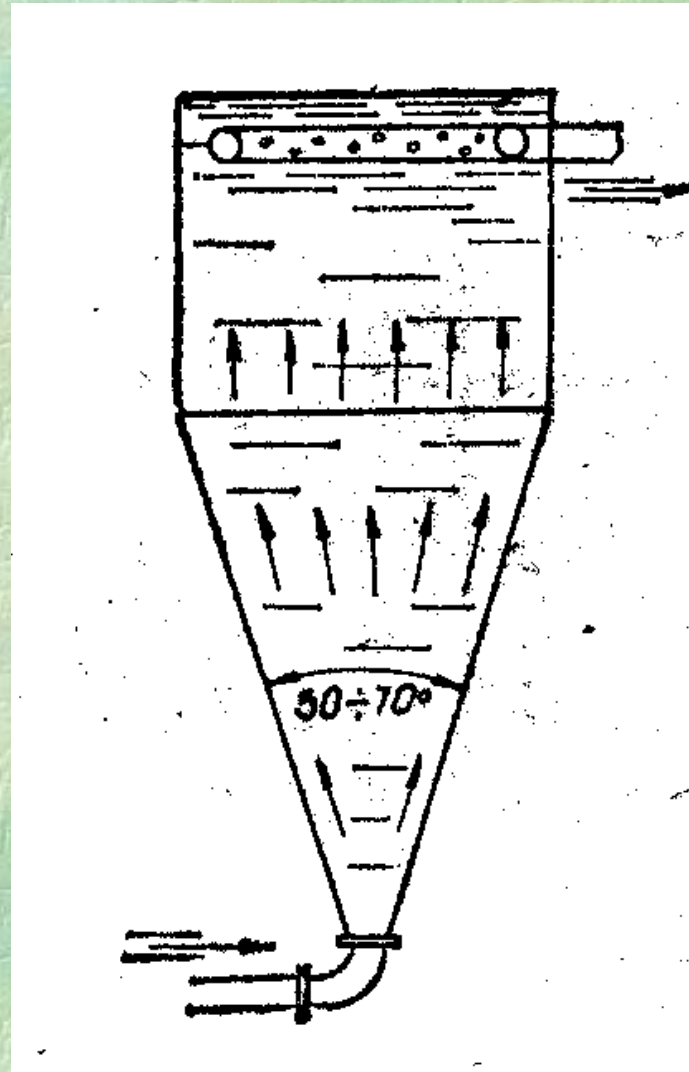
1 - coarse water; 2 - reagent; 3 - water/reagent mixture

Reagents Management Units



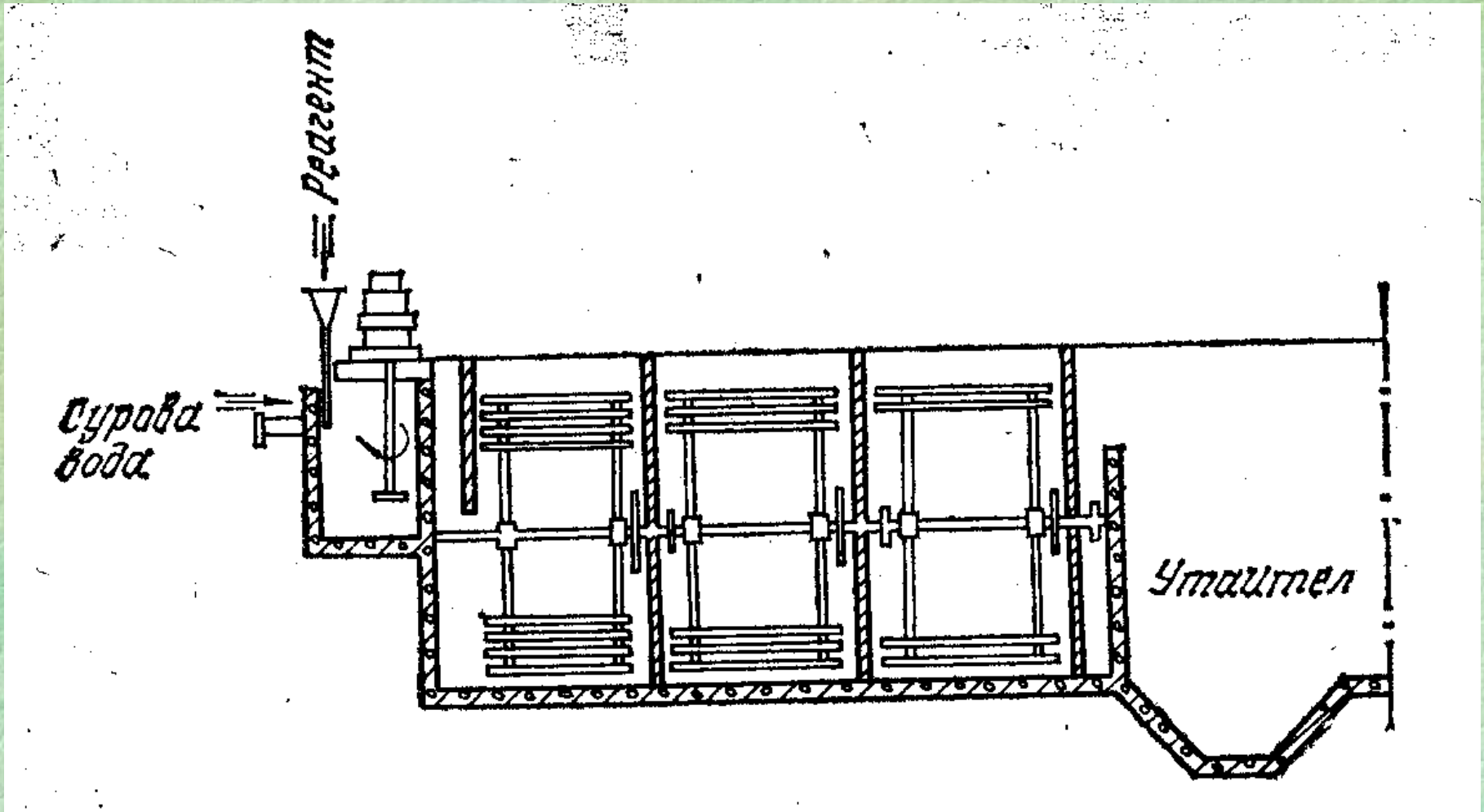
Horizontal Reaction (Flocculation) Chamber with Baffles¹⁷

Reagents Management Units



Vertical Reaction (Flocculation) Chamber of Eddy Type

Reagents Management Units



Reaction (Flocculation) Chamber with Mechanical Agitation