UNSTABLE SUSPENSION

Unstable suspensions are those in which the particles agglomerate rapidly.

There are two forces acting on two negatively charged particles

1. Repulsive Force
2. Vander Wall Force
3. REUPULSIVE FORCE (VR):-

This force is due to similar charge and varies exponentially of the separating distance as the particles repel each other.

1. VANDER WALL FORCE(VA):-

These forces are attractive for e irrespective of the charge on the particle .It varies with 1/3 power of separating distance.

VA= d1/3

When negatively charge particle (Coagulation) are added, the barrier will breakup.

FLOCCULATION

The rate of agglomeration/flocculation depends upon the following

* 1. Number of particles present
  2. The relative volume which they occupy in basin
  3. The velocity gradient (G) in the basin

Q. What do you understand by term velocity gradient?.

Ans: It refer to rapid dispersion of chemical (Coagulants) in raw water and requires higher degree of turbulence & power dissipation.

Mathematically it is the rate of velocity per unit distance or change in velocity per unit length.

V= m/sec L=m

V

t

G= V/L = dL / (dt\*L)

G = m/ (sec x m) =sec-1

Normally G=25-100 sec-1

L

Initially G value should be more & then it should decrease

Means

G=

P= Watts

V=Volume

**Coagulant Dose:-**

Generally it is expressed as grain/gallon (gpg)

1 gpg = 7.1 mg/l (US gallon)

Coagulant dose varies from 0.2 5gpg but the actual dose is found by “JAR TEST”. It depends upon PH, turbidity, chemical composition of water (Alkalinity, dissolves solid etc) temporary mixing conditions.

JAR TEST

The purpose of the Jar test is to select the appropriate type and required amount of coagulant.

PROCEDURE:-

1. One or two liter of water sample is placed in each of six beakers.
2. The coagulant solution of strength 10 mg/1 ml solution is prepared in distilled water.
3. The required amount of coagulant and lime is added to each sample while stirring vigorously continuous flash mixing for 10 sec at max speed of 100 rpm.
4. The sample is flocculated by mechanical flocculator for 20-30 min at rate of 30-40 rpm.
5. The sample is allowed to rest for 20-30 minutes & then clarified (settled) water is siphon for analysis.
6. PH value, turbidity, alkalinity etc are determined for each sample and the one giving the desirable value is selected at the coagulant dose (optimum dose).

NOTE:- Coagulant provides H+ to make the solution acidic therefore we add lime to make solution non-acidic.

Check PH, turbidity, alkalinity and Co2 before and after test.

**ASSIGNMENT**

Write in your class notes

**TYPES OF FLOCULATION (FLOCCULATORS)**

1. Baffled Flocculation
2. Mechanical Flocculation
3. Air Agitation
4. Hydraulic Jump

**FILTERATION**

Filtration is a process of removal of suspended solid (SS) from water by passing through some granular media like sand (Most commonly used).

* Removes S.S and colloidal particles
* Reduce no. of bacteria

**FILTERS**

1. Pressure Filter
2. Gravity Filter
   1. Slow gravity filter
   2. Rapid gravity filter
3. **Pressure Filter:**

* It consists of closed vessel through which water passes under pressure.
* They are generally cylindrical in form. (fig)
* It is used for small scale water treatment i.e. for swimming poles and industries (Not for municipal use).
* Filtration rate is very high 120-300 m3/m2 day. (2-5 gal/ft2 min)

1. **Slow Sand Filters:**

They are suited for rural areas because of

1. Simple operation
2. Require considerable space

**Characteristics:**

* Slow rate of filtration (o.1 ---0.4 m3/m2 hr)
* Bacterial removal is high
* No back washing
* Easy cleaning (Scrapping surface layer of sand)

**ESSENTIAL PARTS**

1. Enclosure tank
2. Under drainage system
3. Base material
4. Filter media of sand
5. Arrangement inside the filter

(Figure)

1. **Enclosure tank:**

* It is constructed with brick or stone masonary or RCC
* Depth is 2.5 m—3.5m
* As (surface area) 10 m2 to 50m2

1. **Under Drainage System (UDS):**

The filtration water is collected at the bottom of the tank through U.D.S which consist of central main drain and laterals which have opening for collecting water. The laterals are generally 2.5---3.5 in apart (Figure).

1. **Base Materials:-**

It is gravel placed on U.D.S with a depth 30—75 cm.

The gravel is graded placed in layers of 10-15cm.

* Top layer (fine material)(15cm) of 3-6mm size,
* Intermediate layer (15cm) of 6—20mm size
* Intermediate layer (15cm) of 20—40mm size
* Lowest layer (15cm) of 40—65mm size

1. **Filter Media of Sand:**

Its depth varies from 60-90 cm

Effective size varies from 0.2---0.3mm

Uniformity co-efficient varies from 2-3

Uniformity co-efficient= D60/D10

**Effective size (D10):**-

It is the size of sieve through which 10% of Sand will pass.

ARRANGMENT INSIDE THE FILTER

1. A vertical air pipe in layer of sand for proper working
2. Head loss measuring devices
3. Devices to control head over the sand layer
4. Device for controlling rate of flow e.g. adjustable telescopic tube etc.

WORKING OF SLOW SAND FILTER (S.S.F)

Water from sedimentation tank is allowed to enter the S.S.F through inlet chamber. It descends through filter media and purified .It is the collected in the central drain of under water drainage system and from there it is brought the Base material and then outlet chamber. Then it is brought to the clear water storage tank. The entire suspended solid are trapped in the sand layer.

**RAPID SAND FILTER (R.S.F)**

**(GRAVITY TYPE)**

The disadvantage of S.S.F is large area is required and rate of filtration is low.

R.F can be increased by

1. Increasing the size of sand (R.S.F)
2. By passing water under pressure (By pressure Filter)

ESSENTIAL PARTS

1. Enclosed tank
2. Under Drainage System (U.D.S)
3. Base Material
4. Filter Media of Sand
5. Appurtenance
6. **Enclosed tank**

* Made of masonry or concrete
* Sides and floor are water proof
* Depth 2.5—3.5 m
* Surface area 10—50m2

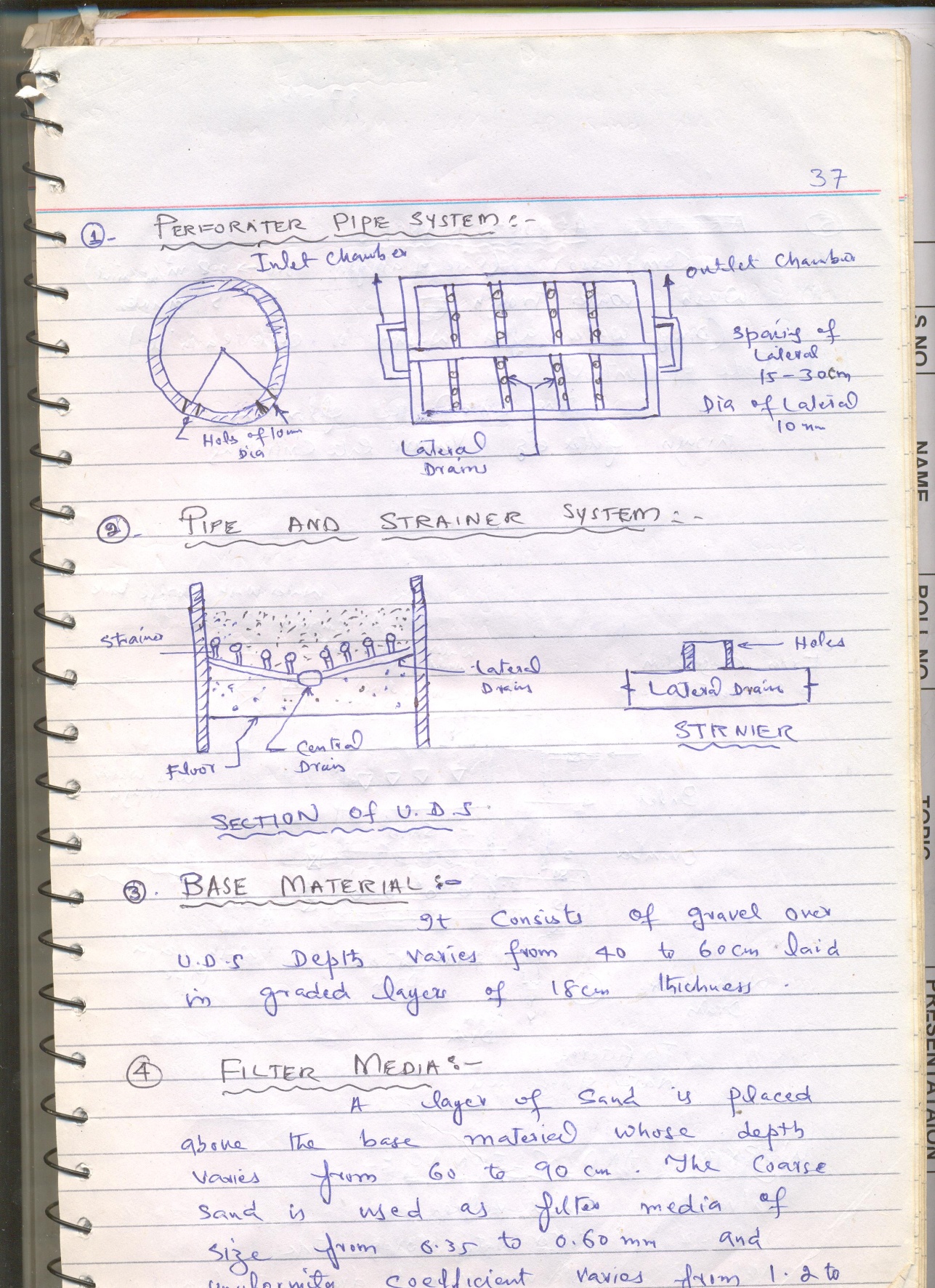
1. **Under Drainage System(U.D.S)**

Purpose

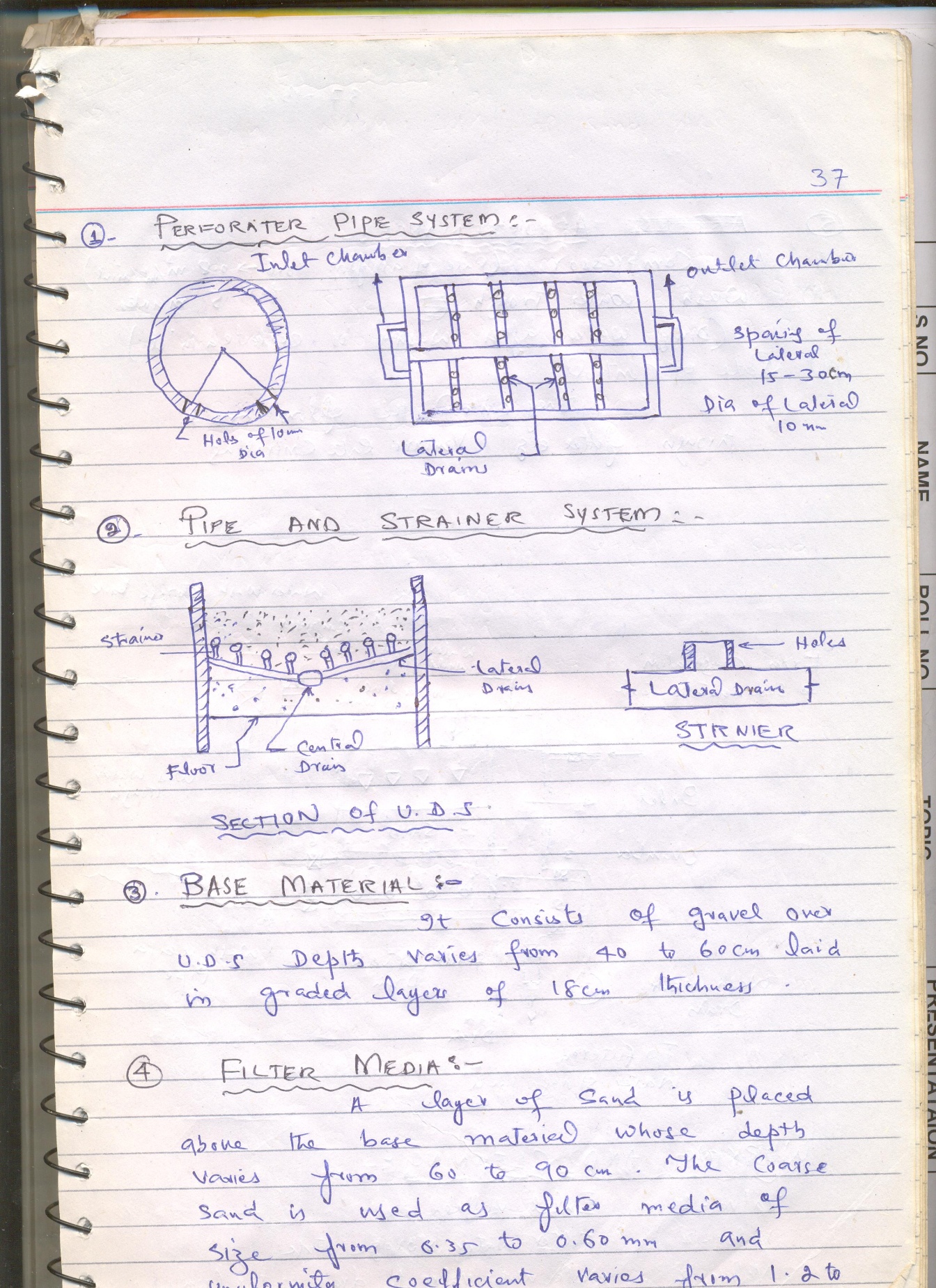
* To collect filter water at the bottom
* Distribute water during back washing

Under Drainage system is of two types:

1. Perforated pipe system
2. Pipe and Strain system
3. **Perforated pipe system**



1. **Pipe and Strain system**



1. **Base Material:**

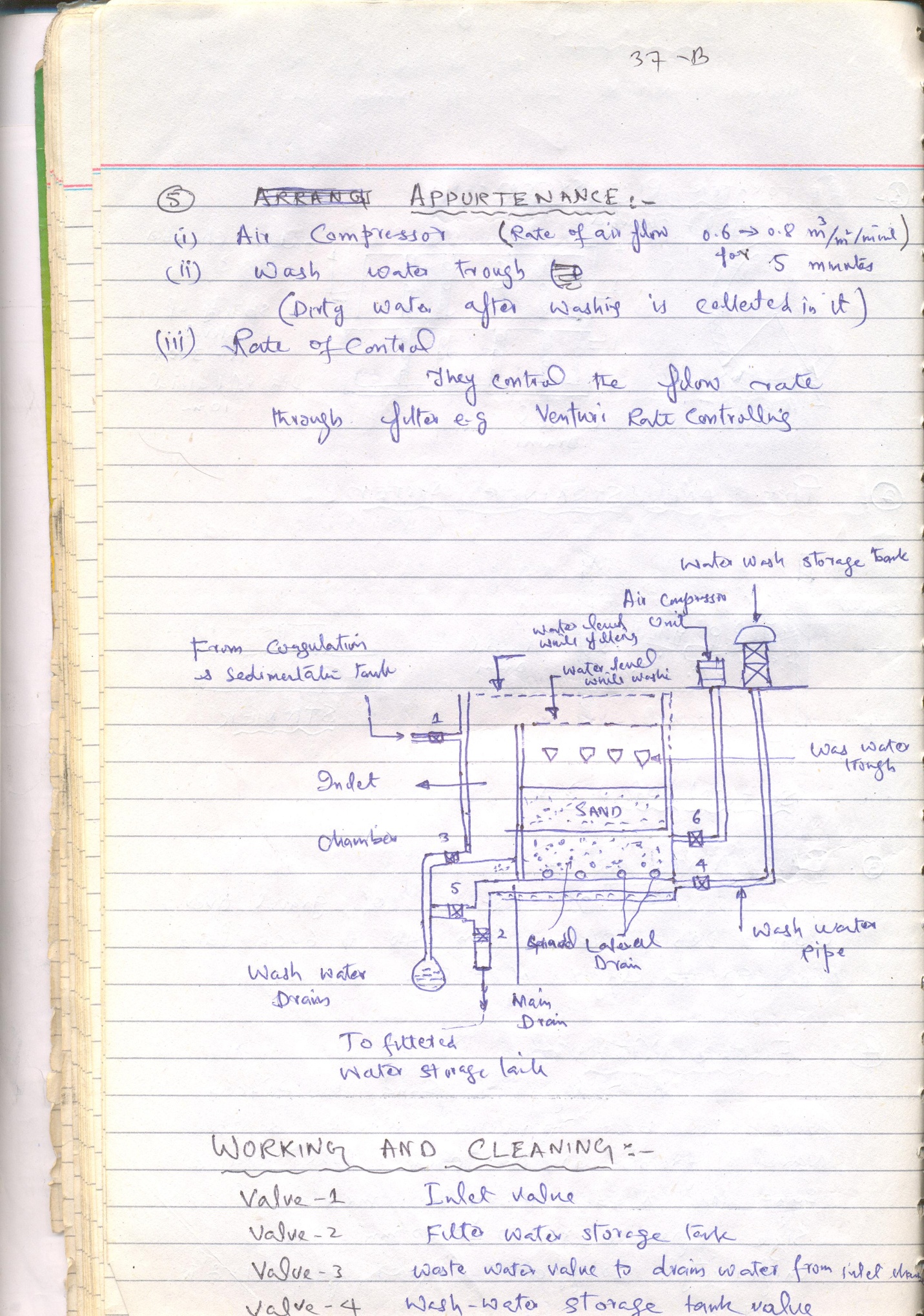
It consists of gravel over U.D.S depth varies from 40 to 60cm laid in graded layers of 18cm thickness.

1. **Filter Media:**

A layer of sand is placed above the base material whose depth varies from 60cm to 90 cm. The coarse sand is used in filter media of sized from 0.35—0.65mm and uniformity co-efficient varies from1.2—1.7.

**APPURTENANCE:-**

* Air Compressor (Rate of flow 0.6-0.8 m3/m2. Min for 5 minutes)
* Wash Water trough
  + Dirty water after washing is collected in it.
* Rate of Control
  + They control the flow rate through filter e.g. Venturi rate controlling

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**WORKING AND CLEANING**

Valve-1 Inlet Value

Valve-2 Filter water storage tank

Valve-3 Waste water valve to drain water form inlet chamber

Valve-4 Wash water storage tank valve

Valve-5 wash water valve to drain water from main drain.

Valve-6 Compressed air valve

Valve-1 is open and water from sedimentation tank is allowed to enter the filter.

Valve-2 is opened to carry filter water to filter water storage tank. All other values are kept in closed position. Thus, when filter is in working condition valve-1 and 2 are in working position.

**CLEANING OR WASHING POSITION**

1. Valve-1 and 2 are closed.
2. Valve-4 and 6 are opened. The wash water is forced in the upward direction through U.D.S, base materials and filter media of sand. The compressed air helps the cleaning process.
3. The value-6 is closed and valve -3 is opened to carry dirty water through inlet chamber to wash water drain.
4. When washing of filter is over, valve-3 and 4 are closed and valve-1 and 5 are opened. Thus, when filter is put into use after washing, the filtered water in the beginning is lead to wash water drain through main drain. This is continued for few minutes to condition the filter.
5. Valve-5 is closed and valve 2 is opened to put the filter in normal working condition.