Textile Industry

- Apparel Industry i.e., manufacture wearing apparel such as shirts, suits, work cloths, etc.
- Fibers used in textile industry can be broadly classified as:
  (1) Cotton
  (2) Wool
  (3) Synthetic, and
  (4) Regenerated

Cotton Textile Mill

- Integrated cotton textile mill produce its own yarn from the raw cotton.
- Production of yarn from raw cotton includes steps like:
  - Opening and cleaning
  - Pickling
  - Carding (process of brushing raw or washed fibers to prepare them as textiles)
  - Drawing,
  - Spinning,
  - Winding,
  - Warping (the set of lengthwise threads attached to a loom)
- All these operations are dry operation and do not generate liquid wastes.

Sources of wastewater Generation

In textile mill liquid waste originate from the following operations:

- **Slashing or sizing** (filling of starch): The warp thread is sized with starch to give *tensile strength* and *smoothness* necessary for subsequent weaving.
  - Starch used is cellulose derivative.
  - The sized cloth is referred as ‘grey goods’ and it contains 8 to 15% slashing compound, which must be removed by finishing.
  - Waste originate from this section due to spills and floor washing.
  - Substitution of starch with low BOD sizes (e.g., carboxy methyl cellulose) can reduce BOD load by > 40%.

Sources of wastewater Generation

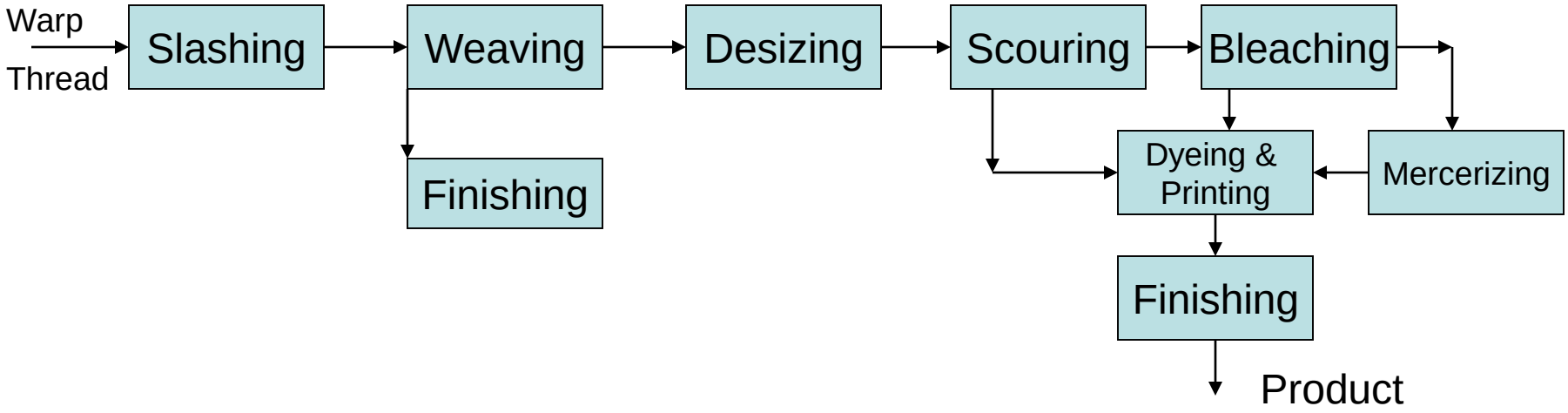
- **Weaving:** The sized threads goes for weaving to prepare cloth.
- **Scouring and desizing:** It is carried out to remove natural impurities and sizing compounds.
  - **Enzymes are normally used**, acids may also be used to hydrolyze starch in desizing.
  - Caustic soda, soda ash, detergents, etc. are used in scouring.
  - Replacement of soap with low BOD detergents may reduce 35% BOD load.
  - About **50% of pollution load** of the mill is originated from this operation.
- **Bleaching:** Oxidizing chemicals like peroxides and hypochlorites are used to remove natural colouring materials.
  - This section contributes to about 10% of pollution load.

Sources of wastewater Generation

- **Mercerising:** Passing the cloth through 20% caustic soda solution. The process **improves strength, elasticity, luster, and dye affinity of cloth**.
  - Waste from this section is recycled after NaOH recovery.
  - Negligible waste generates from this section with low BOD and high alkalinity.
- **Dyeing:** It is carried out using different dyes and auxiliary chemicals, e.g., naphthol dyes, vat dyes, sulphur dyes, direct dyes, etc.
  - Different chemicals are used along with different dyes and colour is developed either by chemical oxidation or air oxidation or reduction depending on the type of dye.
  - Colour from the dyes vary widely and although those are not usually toxic, they are aesthetically objectionable.
  - Thickened dyes along with printing gums and necessary auxiliaries are used for printing and subsequent fixation.
  - After fixation of the print, the fabric is given thorough wash to remove unfixed dyes.

Sources of wastewater Generation

- **Finishing section:** Imparts various finishes to the fabrics. Chemicals such as *starch, dextrines, natural and synthetic waxes*, synthetic resins etc. are used.



Flow diagram of cotton textile mill

Composition of Wastewater

- Wastewater contains starch, carboxymethyl cellulose, NaOH, detergents, peroxides, hypochlorites, dyes and pigments, gums, dextrins, waxes, sulphides, sulphates and soap.
- Composition of composite cotton textile mill:

Parameter	Textile 1	Textile 2
pH	9.8 to 11.8	5.9 to 11.0
Total alkalinity, mg/L $CaCO_3$	1735	--
BOD, mg/l	760	150 – 250
COD, mg/l	1420	370 - 600
Total solids, mg/l	6200	TDS = 1800 – 4000 TSS = 150 - 1000
Chromium, mg/l	12	2 - 4

Effect of the wastewater on receiving

- Rapid depletion of DO, settlement of solids and subsequent degradation lead to rapid DO depletion and anaerobic condition.
- Alkalinity and sulphides can have toxic effect on aquatic life.
- Some dyes are also toxic and due to colour make water unfit for different uses.
- Sulphides make water corrosive, particularly concrete structures.

CPCB: Wastewater Discharge Standards

- Common Parameters:
  - pH : 5.5 to 9.0
  - SS, mg/l : 100
  - BOD_3 : 150
  - Oil & Grease : 10
  - Bio-assay test: 90% fish survival after 96 hr in 100% effluent
- Special Parameters
  - Chrome (dye) : 2.0 mg/l
  - Sulphide : 2.0 mg/l
  - Phenolic compound: 5.0 mg/l as (C_4H_2OH)
  - SAR : 26

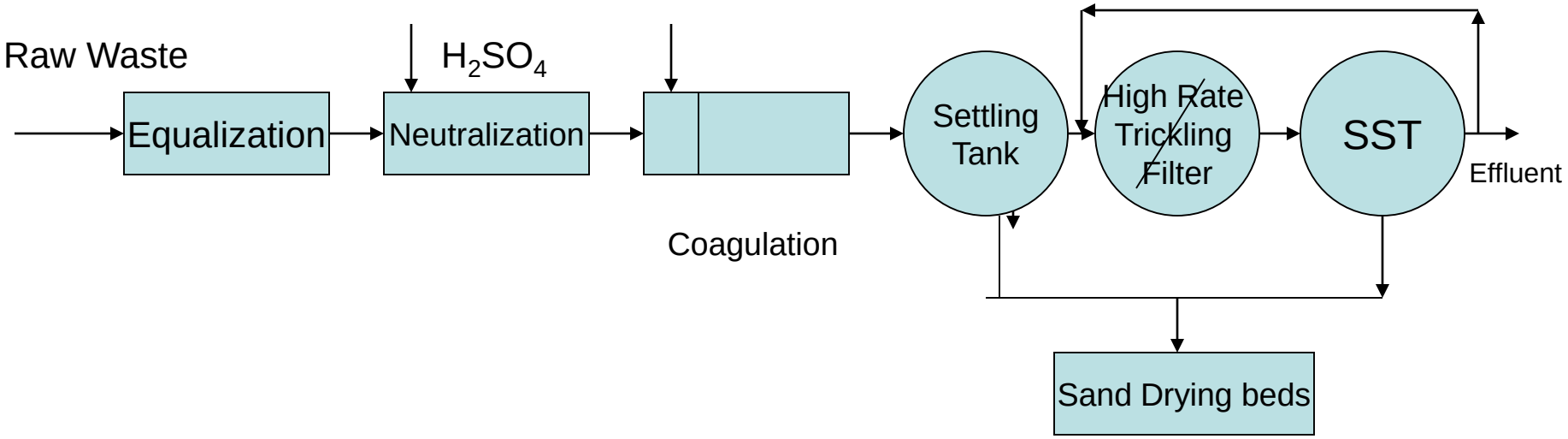
  - The limit of BOD can be lowered to 30 mg/L according to the requirement of the state boards.

Treatment of the wastewater

- Serious consideration should be given for reducing the strength and volume of the wastewater by chemical substitution, chemical and grease recovery and recycling of water.
- Biological treatment of kiering and scouring waste without any pretreatment is difficult.
- The treatment consists of:
  - Segregation, equalization, neutralization, chemical precipitation, chemical oxidation and biological oxidation.
  - Alum ferrous sulphate, ferric sulphate, ferric chlorids are the coagulants used.
  - Lime or sulphuric acid is used for pH adjustment.
  - Composite waste, if free from toxic substances **may be treated efficiently as sewage.** The wastewater normally contains N & P required for biological treatment.

Treatment of the wastewater

- Trickling filter, ASP, WSP are effective.
- Extended aeration is most effective, even without equalization and pretreatment, this eliminates necessity of sludge digestion.
- UASB reactor (30 h HRT) + aerobic CSTR is also successful. In UASB organic matter and colour removal up to 50%.



Flow diagram of treatment of cotton textile mill wastewater