Water Balance And Management

by

Dr. D.D. BASU
Former Additional Director, CPCB
&
Advisor, CSE

What are the Consumption Pattern of Water in Industry?

- Make up for the Cooling Water system
- Make for Fire Water
- Feed to Demineralization Plant
- Process Water
- Service Water
- Sanitary Water

TYPICAL EXAMPLE OF WATER USAGE PATTERN

	1	2	3	4	5
Cooling water make-up (m^3/day)	4800 (32.78)	690 (35.57)	2000 (55.04)	2223 (56.4)	21400 (35.91)
Feed to DM plant (m^3/day)	4800 (32.78)	280 (14.43)	840 (23.12)	1080 (27.4)	11200 (18.79)
Process water (m^3/day)	1200 (8.2)	290 (14.94)	271 (7.46)	271 (7)	15000 (25.17)
Service water (m^3/day)	2400 (16.39)	300 (15.46)	523 (14.39)	250 (6.3)	7000 (11.74)
Sanitary water (m^3/day)	1440 (9.84)	380 (19.58)	--	120 (2.9)	5000 (8.39)
Total (m^3/day)	14640 (100)	1940 (100)	3634 (100)	3944 (100)	59600 (100)

What are the Sources of Waste Water in Industry?

- Cooling Tower Blow down.
- D.M. Plant regeneration Waste Water and Boiler Blow Down.
- Process Waste Water
- Service Water and Strom Water.
- Sanitary Waste Water.

TYPICAL EXAMPLE OF WASTEWATER GENERATION

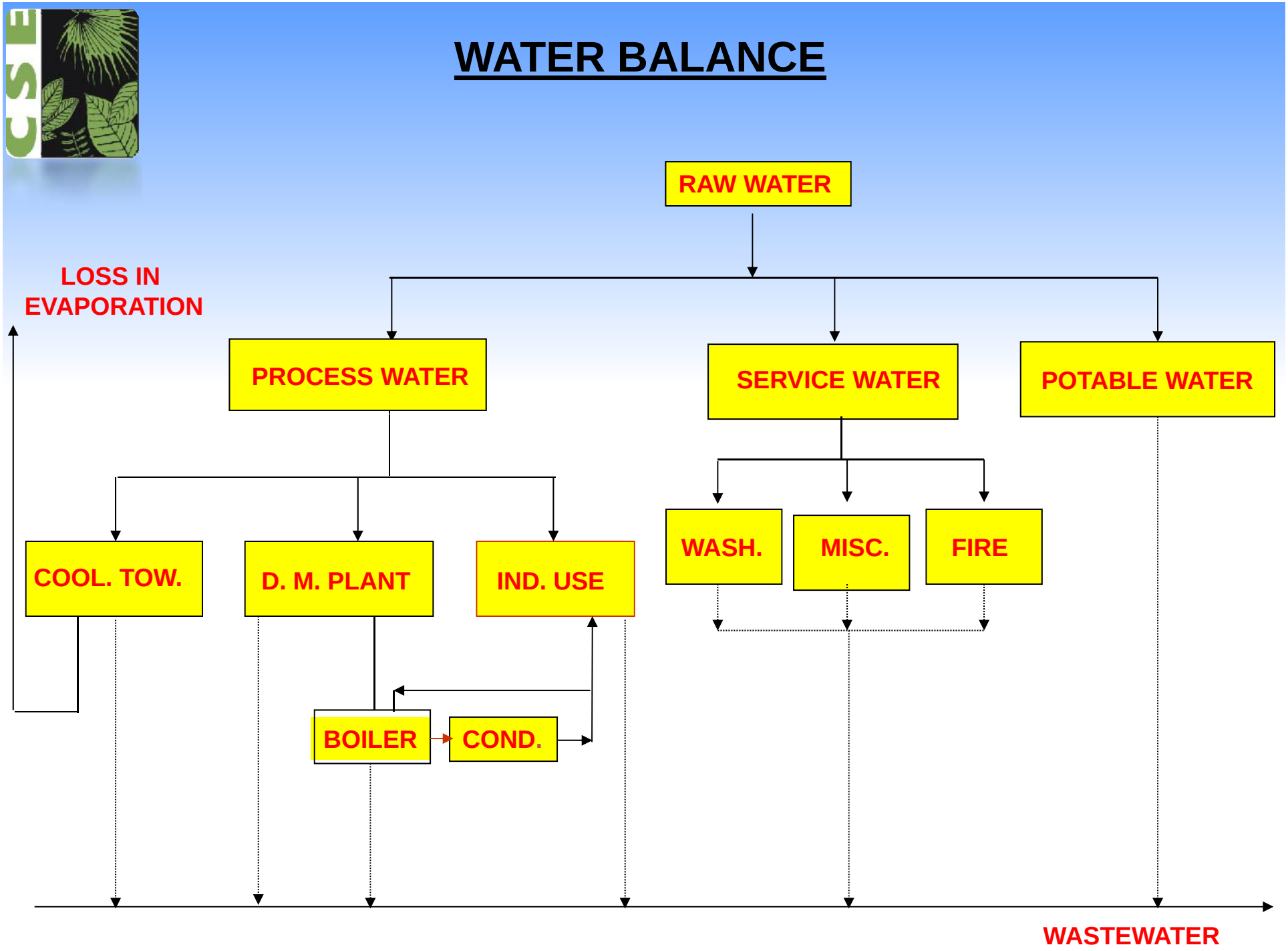
S. No.		Petrochemicals complex	Phenol cumene plant	Caprolactum plant	Large petrochemical complex
1	Cooling tower blow-down	50	*	17	11200
2	DM plant regeneration wastewater	50	3	-	1400
3	Process wastewater	110	12	11	14000
4	Service wastewater	90	13	22	(See note 1)
5	Sanitary wastewater	40	8	-	2500
Total		340	36	50	29100

NOTE:

* - Industry claims insignificant blow-down.

1. Service wastewater quantity is included in the process wastewater

WATER BALANCE



Cooling Water Management

- Functions of Cooling Tower:-

  Cooling Tower regulated temperature by dissipating heat from recirculating water used to cool chillers, air conditioning equipments or other process equipment. Heat is rejected primarily through evaporation. Therfore, by design cooling tower consumes significant amounts of water.

Factors for loss of water

- Evaporation – Major Source
- Drift – Water loss as a mist or small droplets
- Blow down or bleed off – control of concentration of total dissolved solids.
- Basin leaks or overflow – properly operated cooling tower should not have basin leaks or overflow. Good maintenance of system value and basin level control system is required.

The sum of water loss can be replaced by make up water

Make up water = Evaporation + Blow down + Drift

Concentration Ratio - The Key Parameter

A Key parameter used to evaluate cooling tower operations is concentration ratio.

$$\text{Concentration ratio} = \frac{\text{Concentration of TDS in Blowdown water}}{\text{Concentration of TDS in make up water}}$$

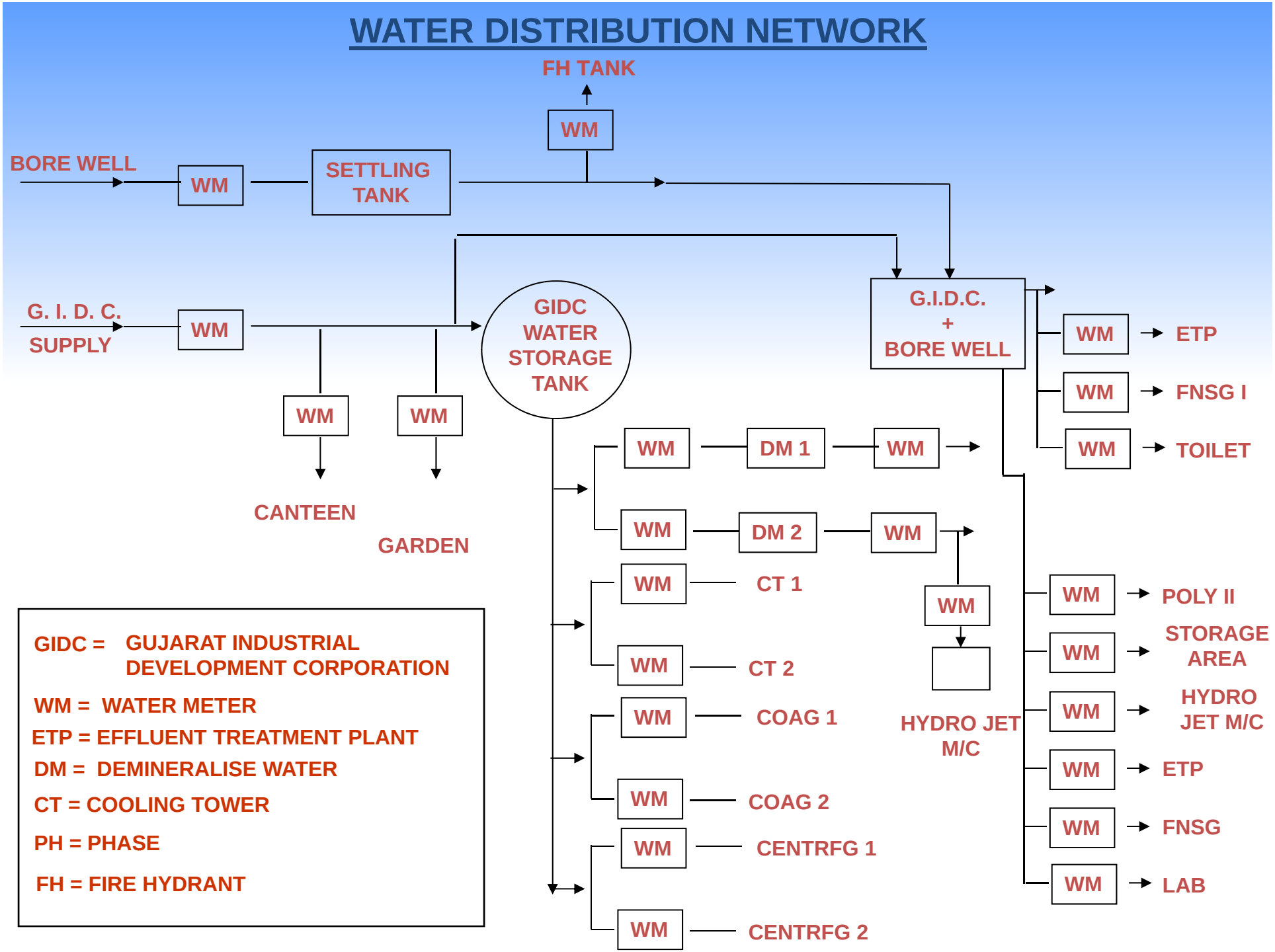
If Concentration ratio is high, water efficiency will be high but scaling, corrosion will be high.

Water quality and Cycle of Concentration

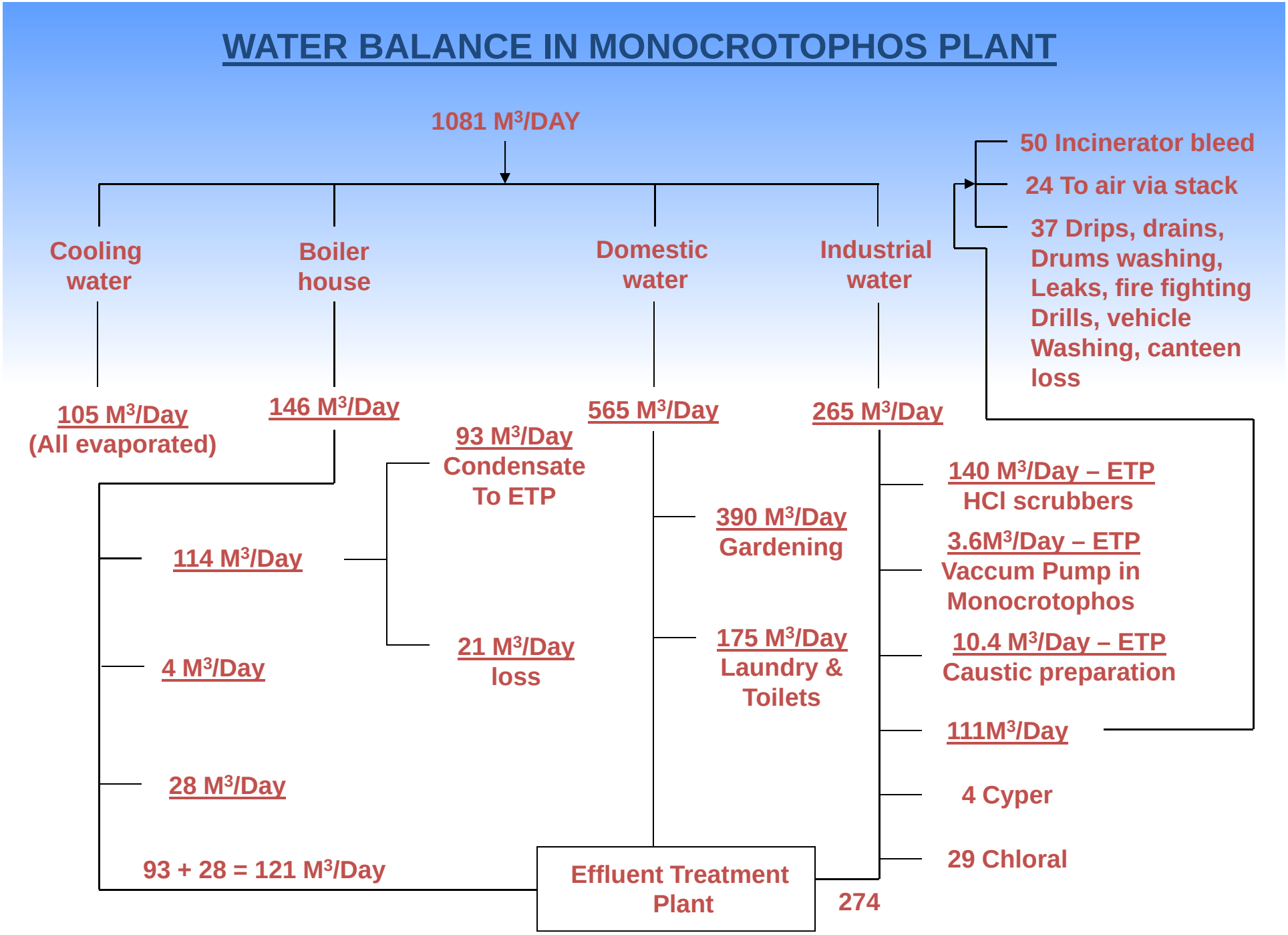
Water Status	Conductivity	Total Hardness mg/l as coc_3	Calcium Hardness	Total Alkalinity	PH
Makeup water	600	300	150	200	7.5
2 coc	1200	600	300	400	8.0
4 coc	2400	1200	600	800	8.5
6 coc	3600	1800	900	1200	6.6
10 coc	6000	3000	1800	2000	9.0

This Indicates 4 to 6 cycle shall be the ideal coc for cooling tower recirculation source guidelines managing water cooling system for owners, operators, environmental managers
SAN JOSE / SANTA CLARA Water pollution control Plants

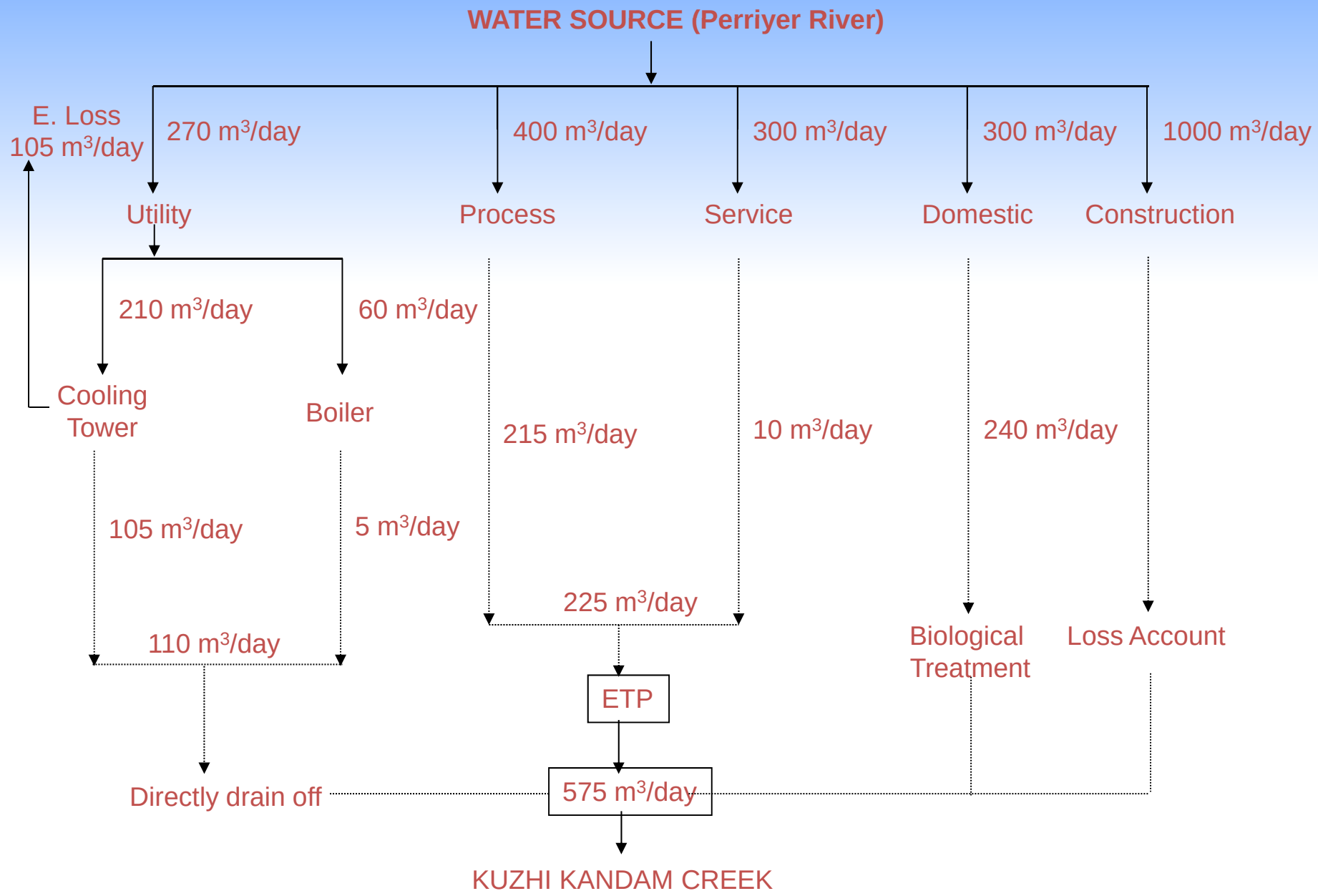
WATER DISTRIBUTION NETWORK



WATER BALANCE IN MONOCROTOPHOS PLANT

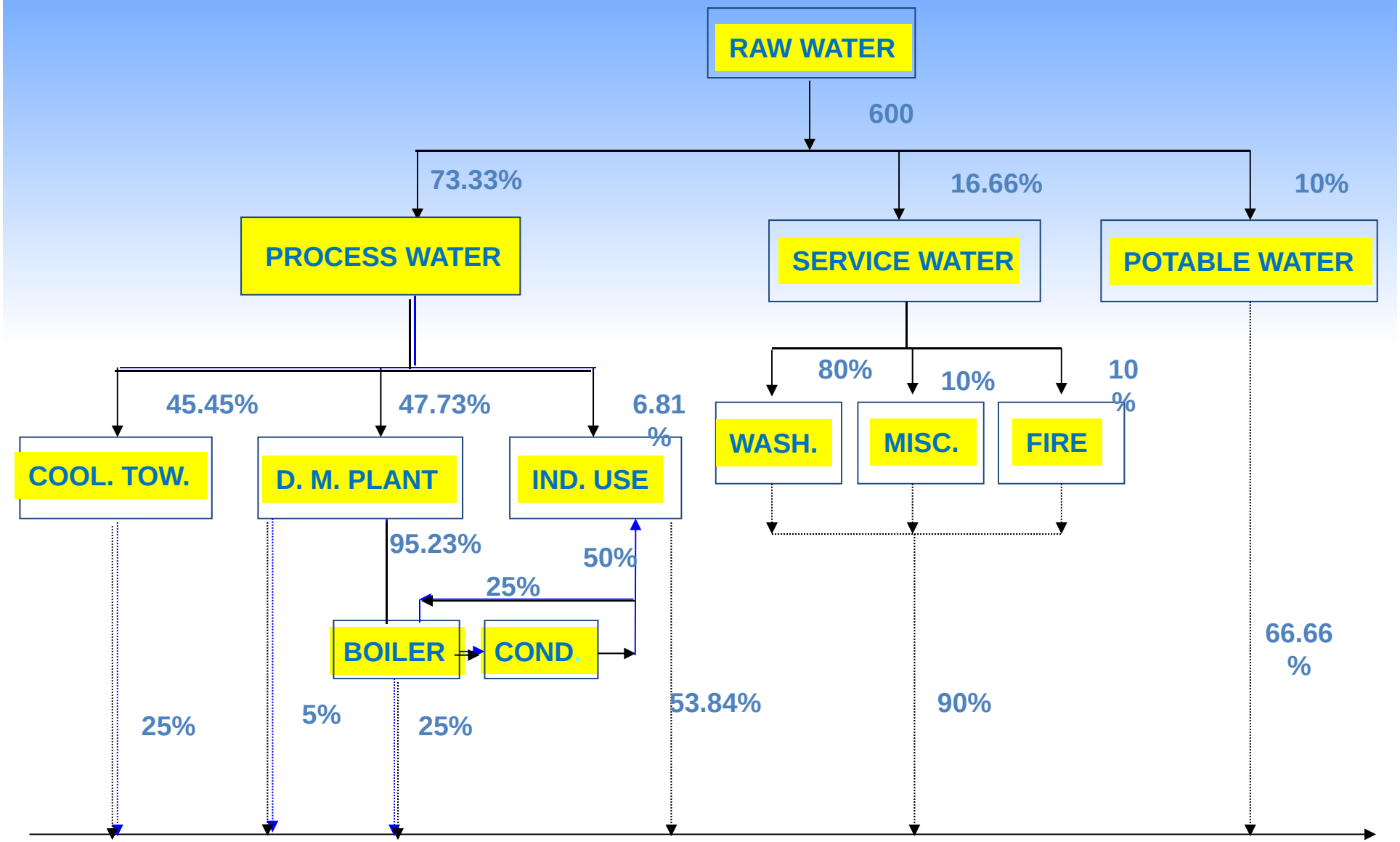


WATER BALANCE IN HIL PLANT



Thumb Rule for Water Balance

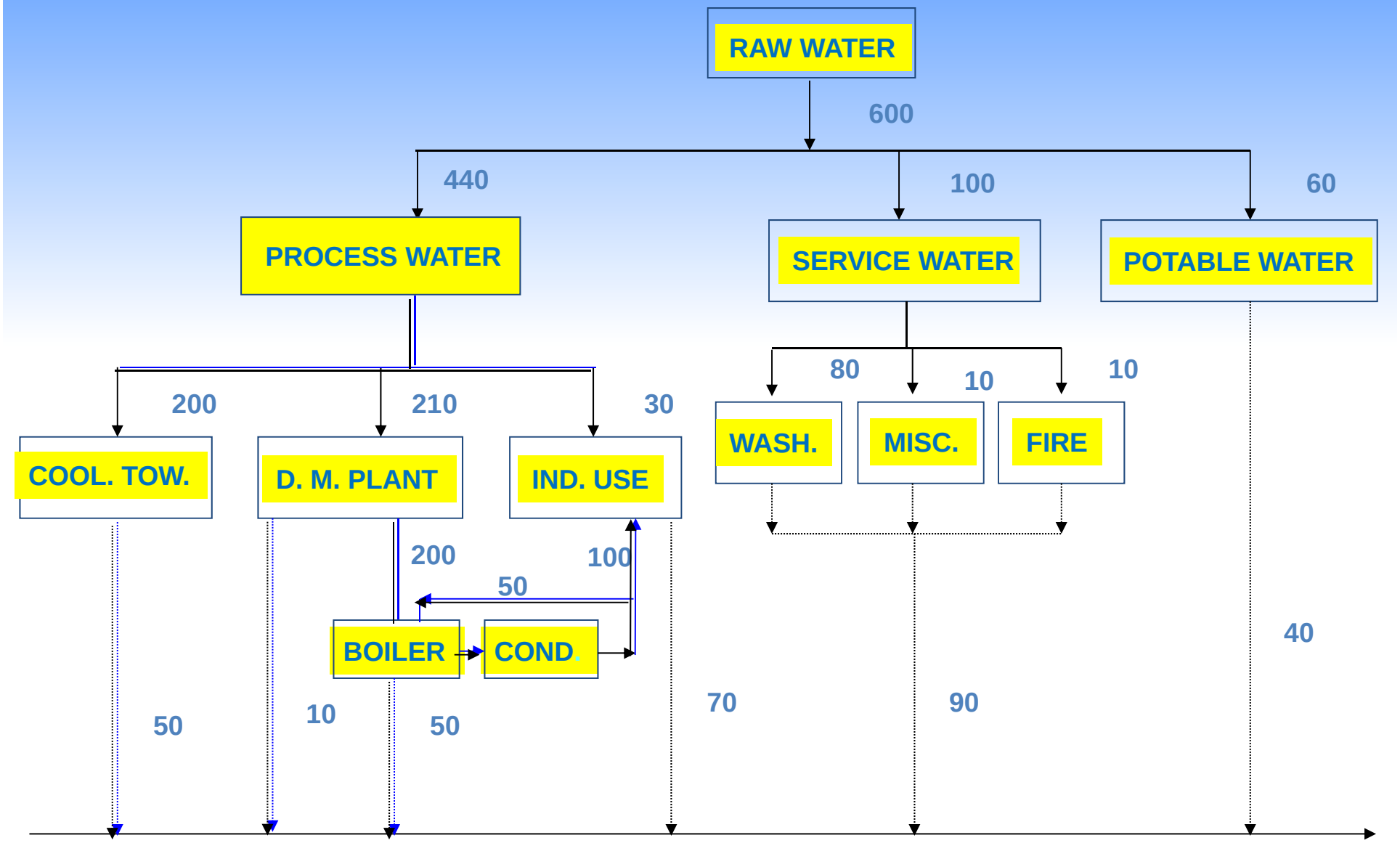
MASS BALANCE OF WATER CONSUMPTION AND EFFLUENT GENERATION



NOTE:

All the values in cubic meter / hour.

MASS BALANCE OF WATER CONSUMPTION AND EFFLUENT GENERATION



NOTE:

All the values in cubic meter / hour.

4 R – Concept

- RENOVATION
- RECYCLING
- REUSE
- RECHARGE

Step by Step Approach on 4R – Concept

- Waste water characterization
- Inter-relationship of solids
- Chemical characterization of total solids
- Approach to develop Renovation/Recycling/Reuse/Recovery

WASTEWATER CHARACTERISATION

WASTE WATER CHARACTERIZATION

Total solid (TS)

Residue after evaporation and dried at 103°- 105° C

Total volatile solids **(TVS)**

Those solids which are burnt off or volatilized when the TS are ignited

Total fixed solids **(TFS)**

Residue that remains after TS is ignited [500 + 50°C]

TVS = TS - TFS

(Portion of TS retained at filter paper and dried at 105°C)

Total suspended solids **(TSS)**

Volatile Suspended Solids **(VSS)**

TSS when burnt off at 500° ± 50°C

Fixed Suspended Solids **(FSS)**

Residue remains when TSS are ignited [500° ± 50°C]

VSS = TSS - FSS

Total dissolved solids **(TDS)**

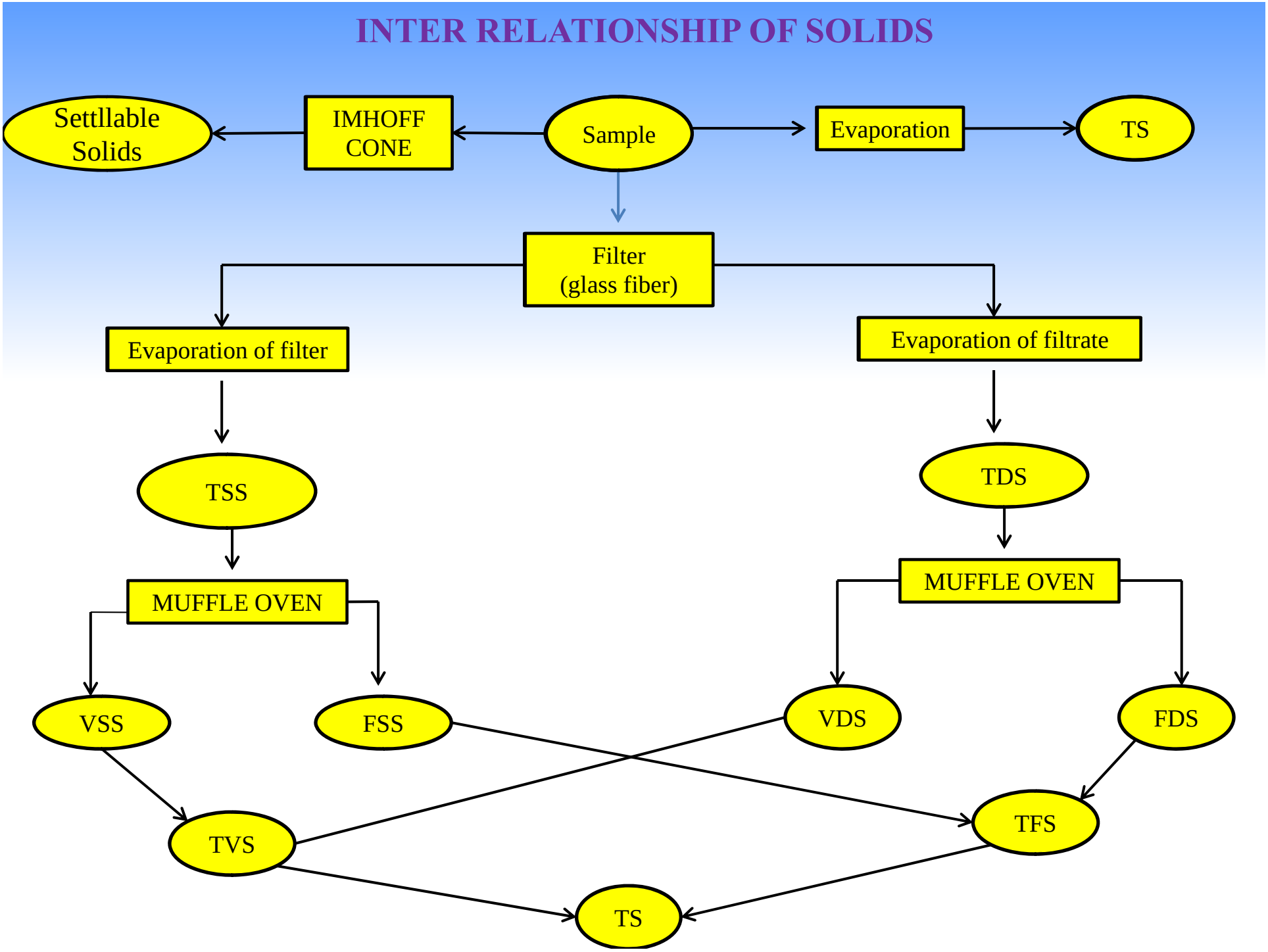
Total Volatile dissolved solids **VDS** (burnt off at 500° ± 50°C)

Fixed Dissolved Solids **(FDS)**

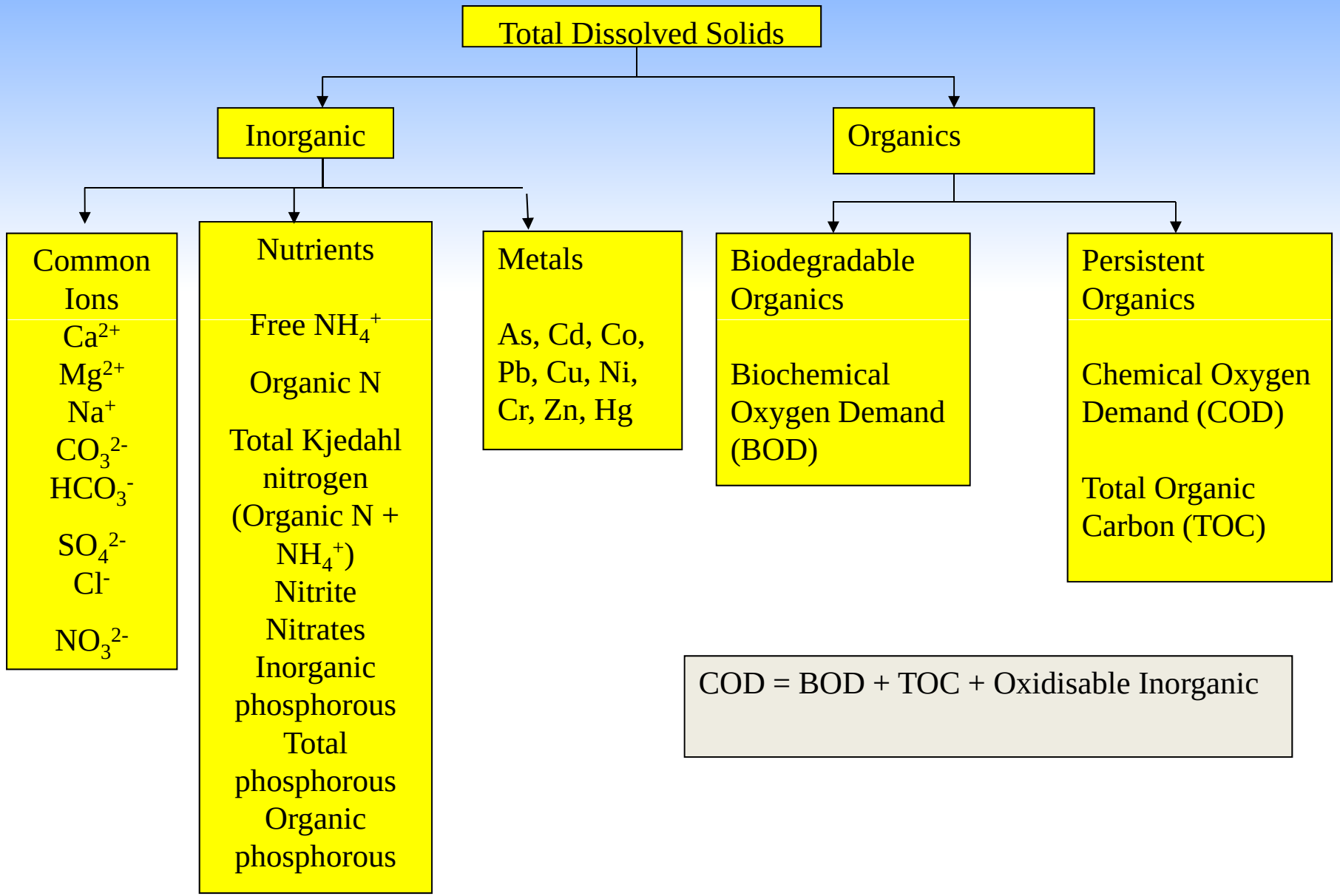
Residue remains when TDS is ignited at [500° ± 50°C]

TDS = TS - TSS

INTER RELATIONSHIP OF SOLIDS

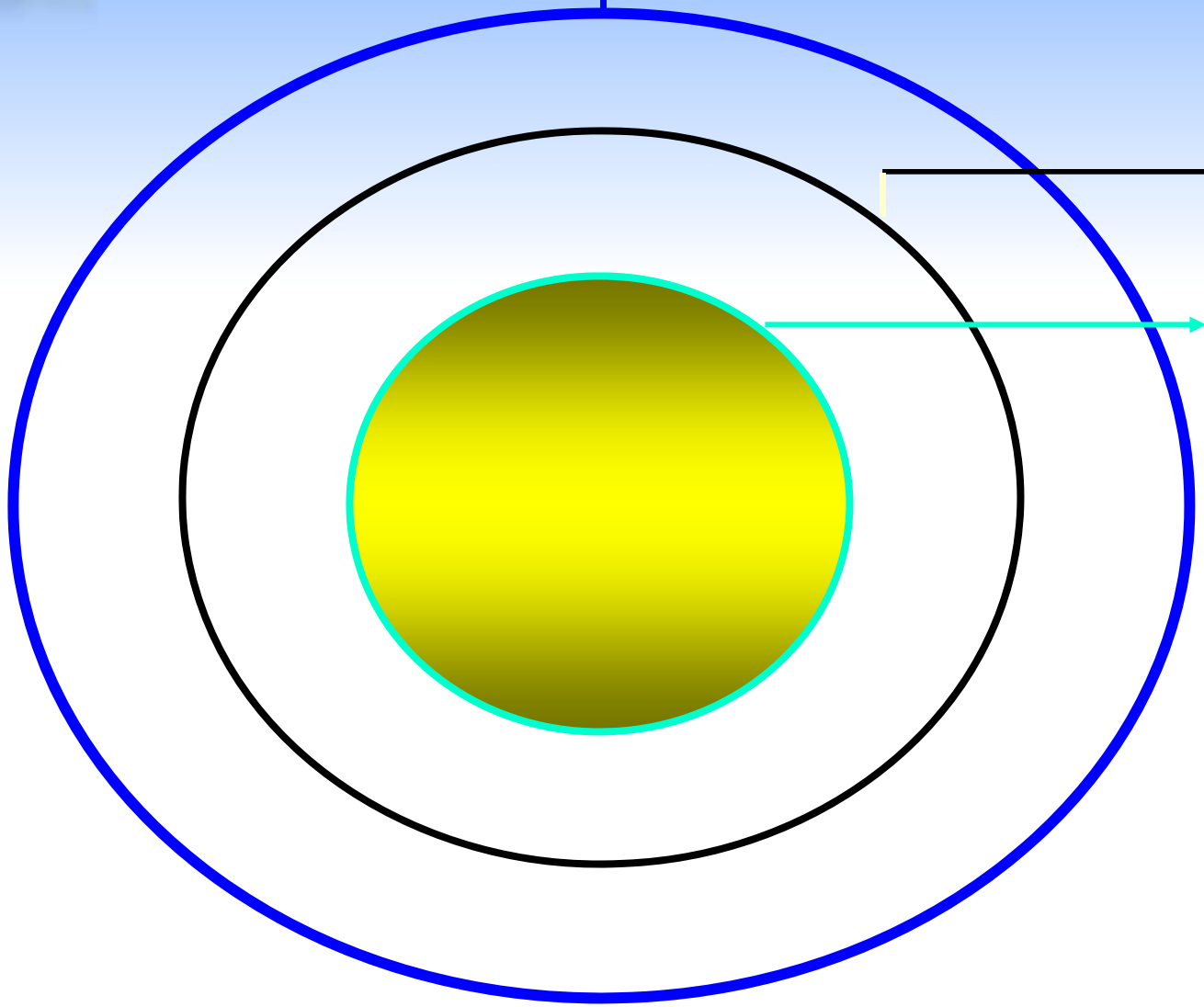


CHEMICAL CHARACTERIZATION OF TOTAL DISSOLVED SOLIDS



COD = BOD + TOC + Oxidisable Inorganic

TDS / BOD / COD RELATIONSHIP



TDS due to inorganic salts

TDS due to persistent organic

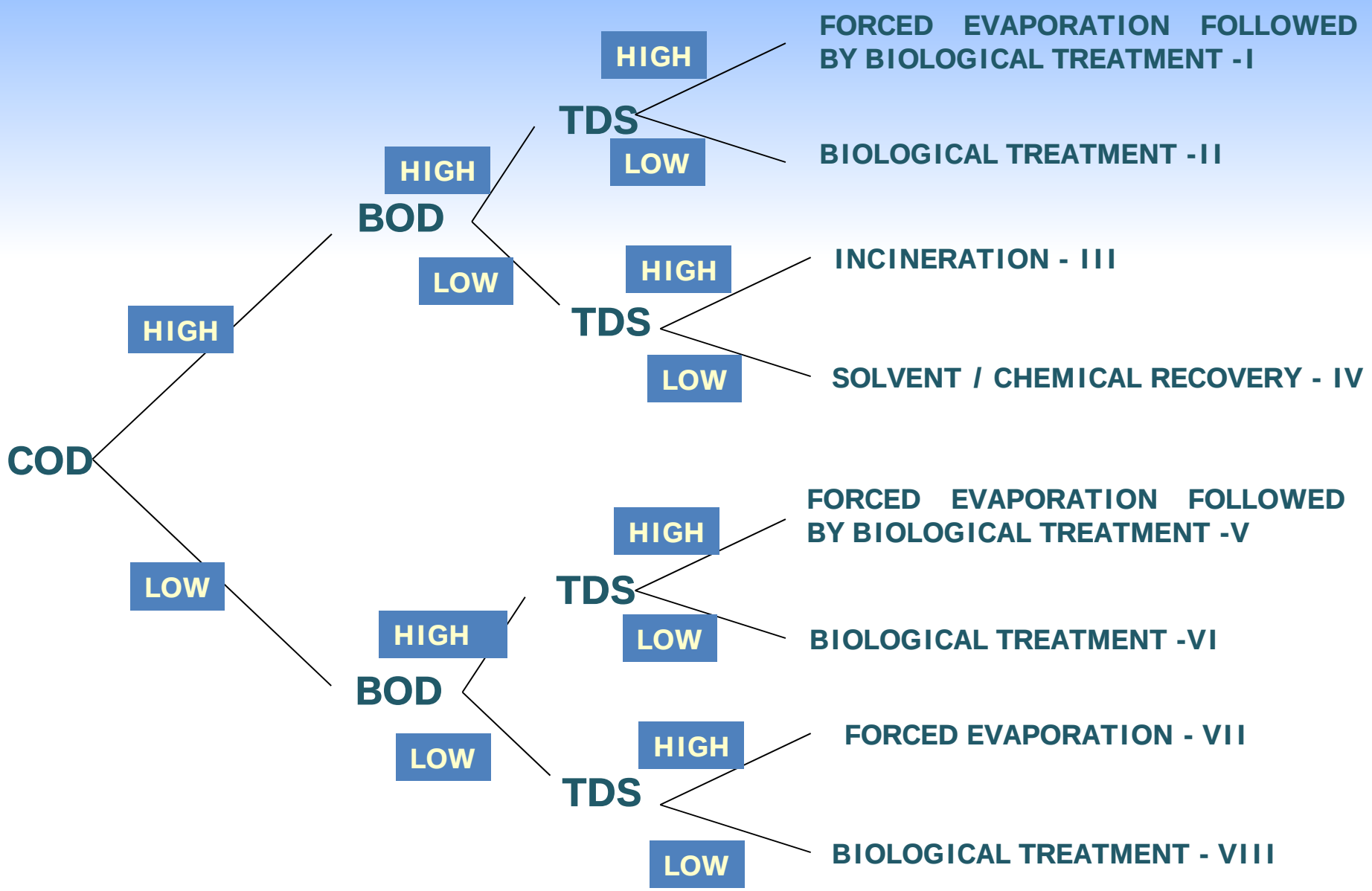
TDS due to biodegradable organic

Approach to develop Renovation/Recycling/Reuse/Recovery

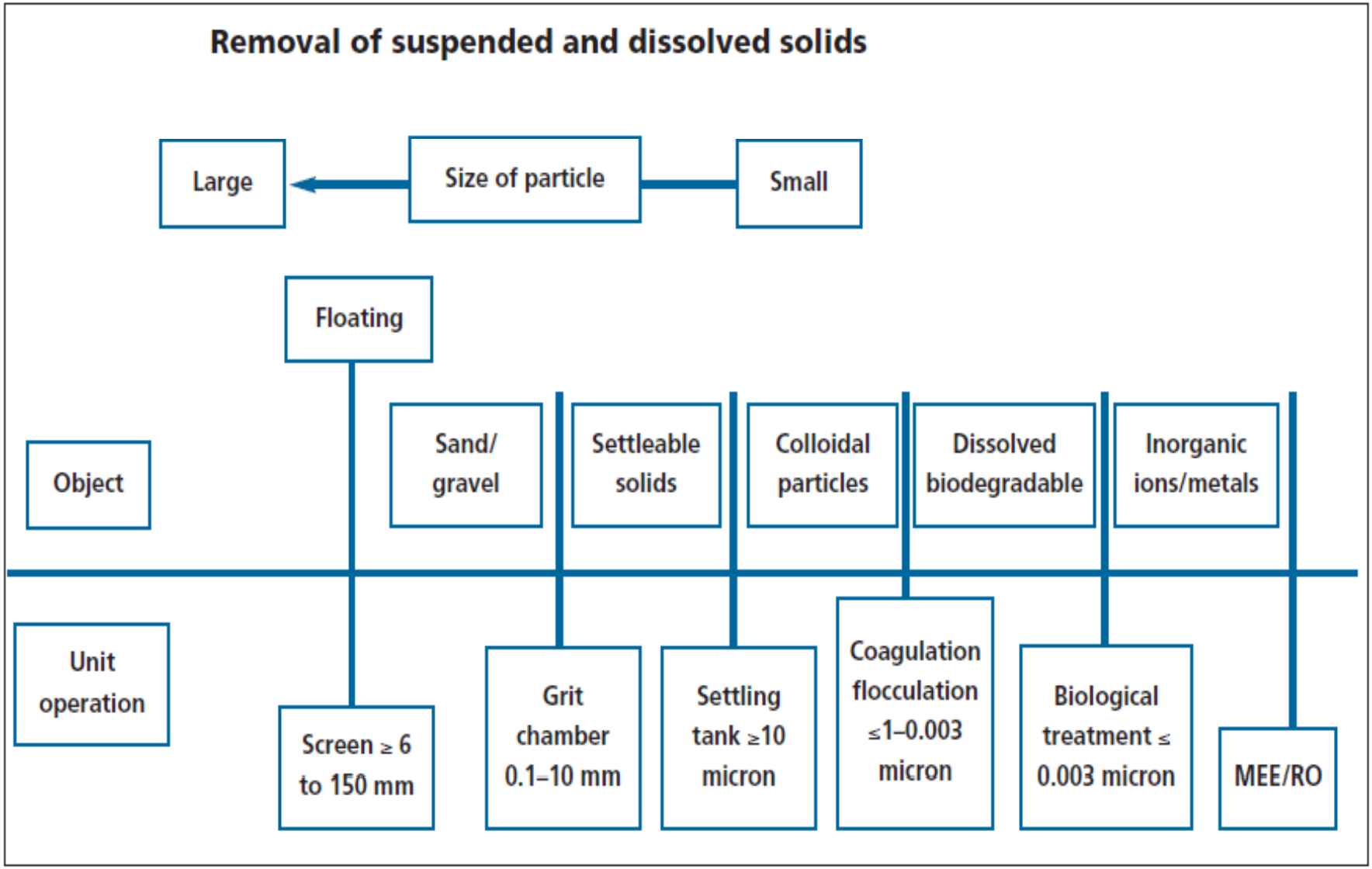
- In plant control
- Treatment option
- Segregation of streams
- ISBL and OSBL

SEGREGATION OF STREAMS

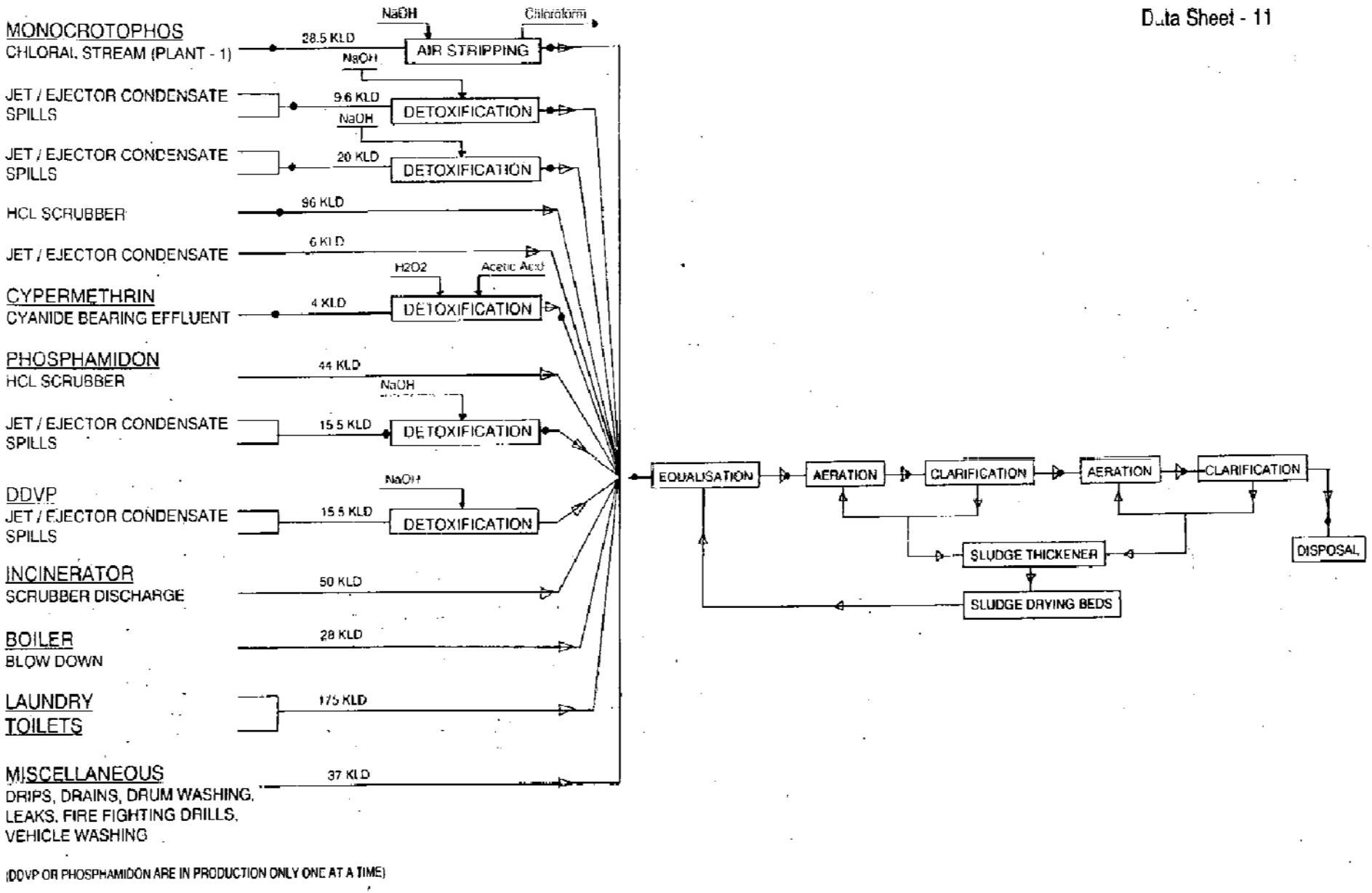
STREAMWISE BEST PRACTICABLE TECHNOLOGY IN CHEMICAL INDUSTRIES

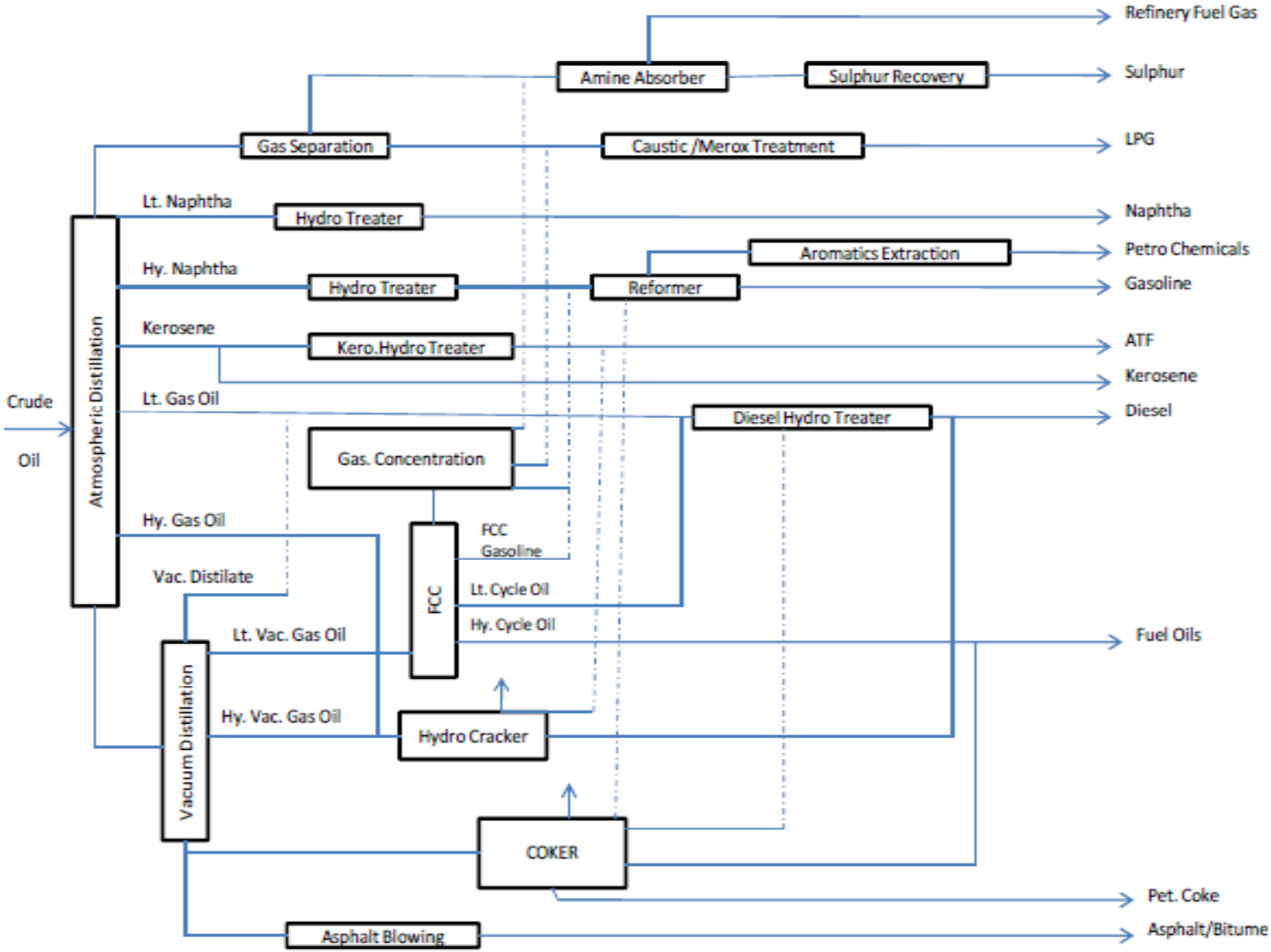


OSBL Treatment



INTEGRETED WASTEWATER SYSTEM (ISBL & OSBL)



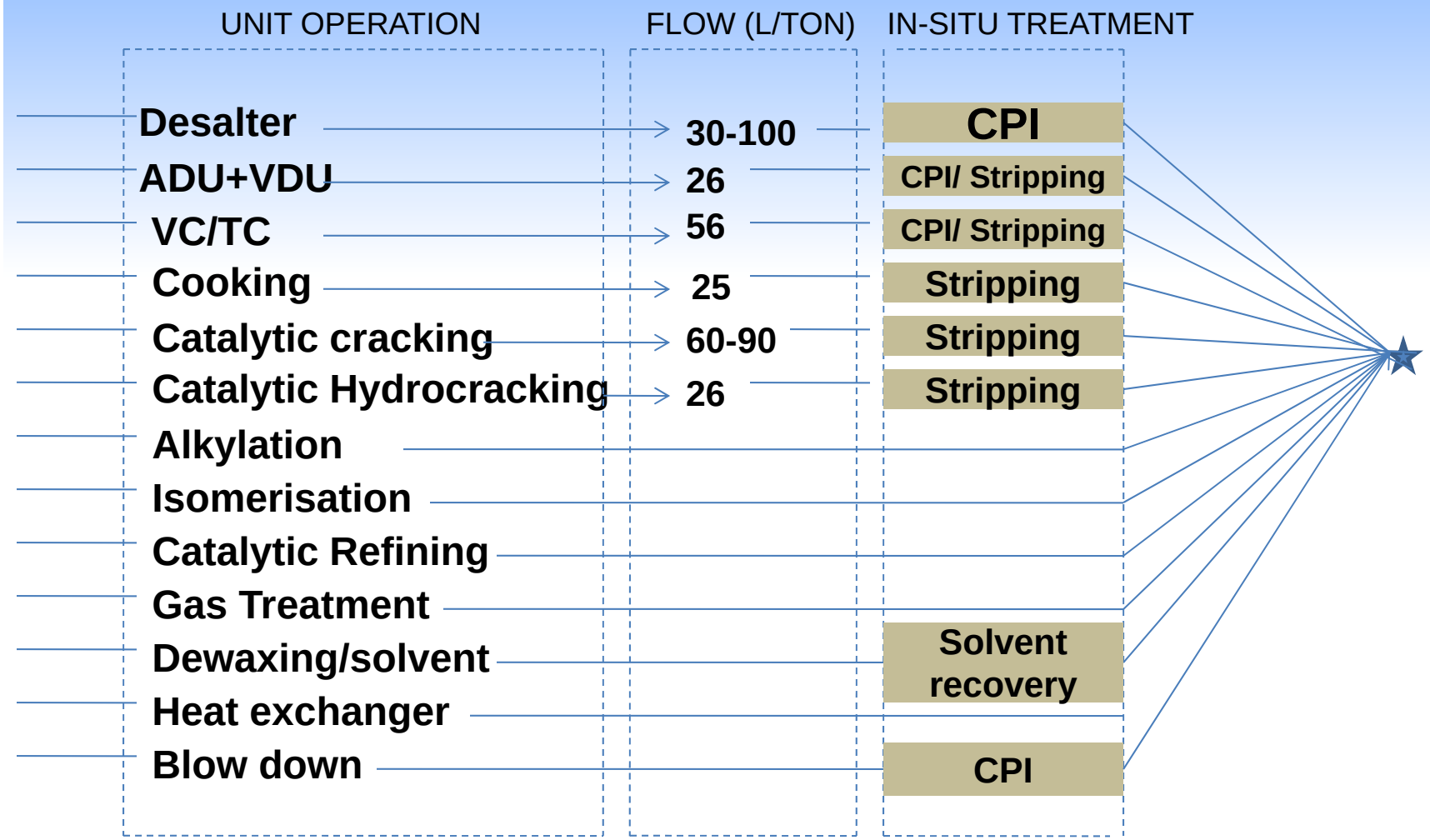

Refinery Fuel Gas
Amine Absorber
Sulphur Recovery
Sulphur
Gas Separation
Caustic /Merox Treatment
LPG
Lt. Naphtha
Hydro Treater
Naphtha
Aromatics Extraction
Petro Chemicals
Hy. Naphtha
Hydro Treater
Reformer
Gasoline
Kerosene
Kero.Hydro Treater
ATF
Kerosene
Crude
Oil
Atmospheric Distillation
Lt. Gas Oil
Diesel Hydro Treater
Diesel
Gas. Concentration
Hy. Gas Oil
FCC
Gasoline
Vac. Distilate
FCC
Lt. Cycle Oil
Hy. Cycle Oil
Lt. Vac. Gas Oil
Fuel Oils
Vacuum Distillation
Hy. Vac. Gas Oil
Hydro Cracker
COKER
Pet. Coke
Asphalt Blowing
Asphalt/Bitume

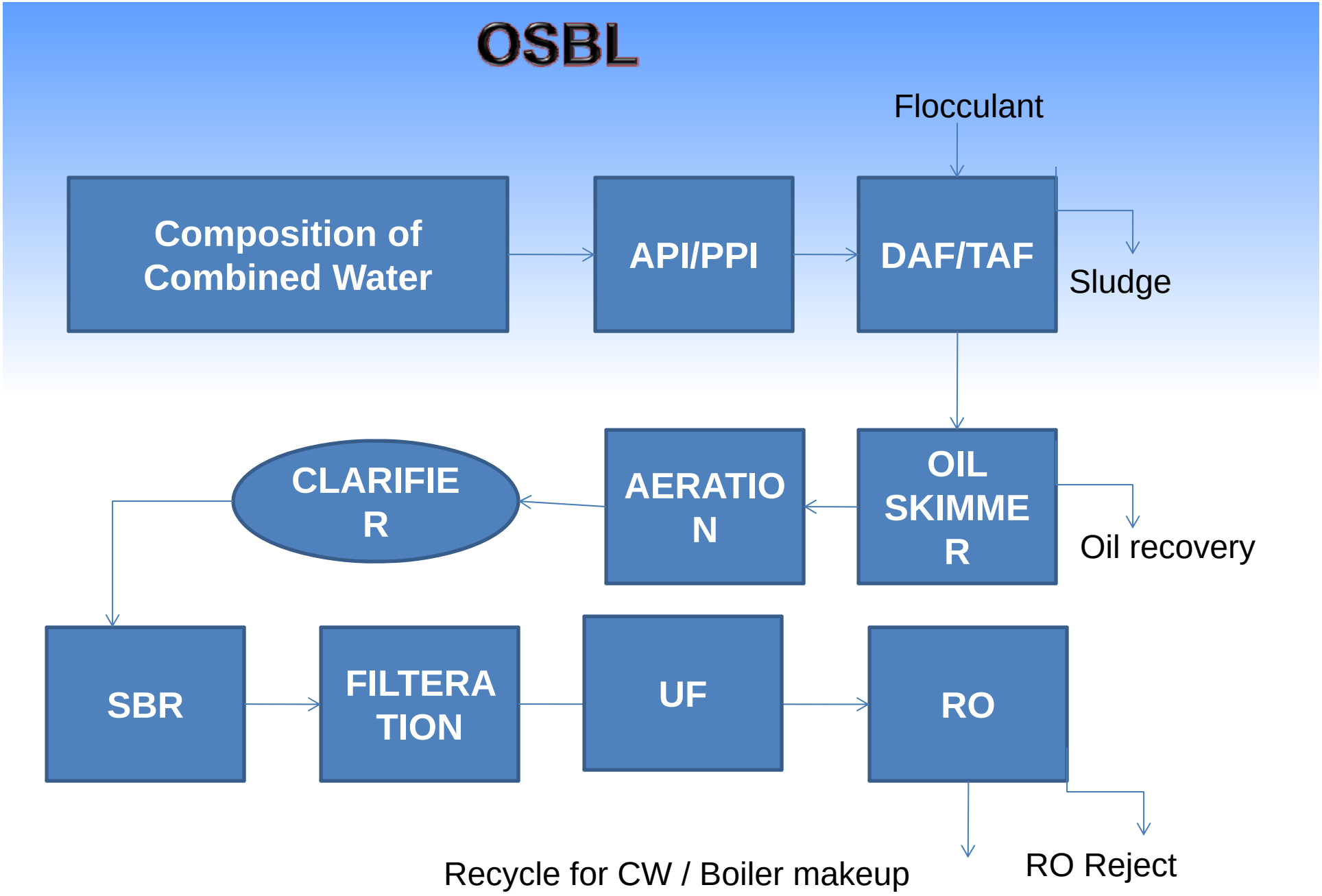
➢ Representative Concentrations of Pollutants in Typical Refinery Effluents

	Oil	H_2S (RSH)	NH_3 (NH_4+)	Phenols	BOD COD TOC	CN- (CNS-)	TSS
Distillation Units	XX	XX	XX	X	XX	-	XX
Hydrotreatment	XX	XX(X)	XX(X)	--	XX	--	--
Visbreaking	XX	XX	XX	XX	XX	X	X
Catalytic Cracking	XX	XXX	XXX	XX	XX	X	X
Hydrocracking	XX	XXX	XXX	--	X	-	-
Lube Oil	XX	X	X	-	XX	-	-
Spent Caustic	XX	XX	-	XXX	XXX	X	X
Ballast Water	X	-	-	X	X	X	X
Utilities (Rain)	-(X)	-	-	-	X	-	-
Sanitary/Domestic	-	-	X	-	X	-	XX

Key: X=<50 mg/l; XX=50-500 mg/l; XXX=>500 mg/l

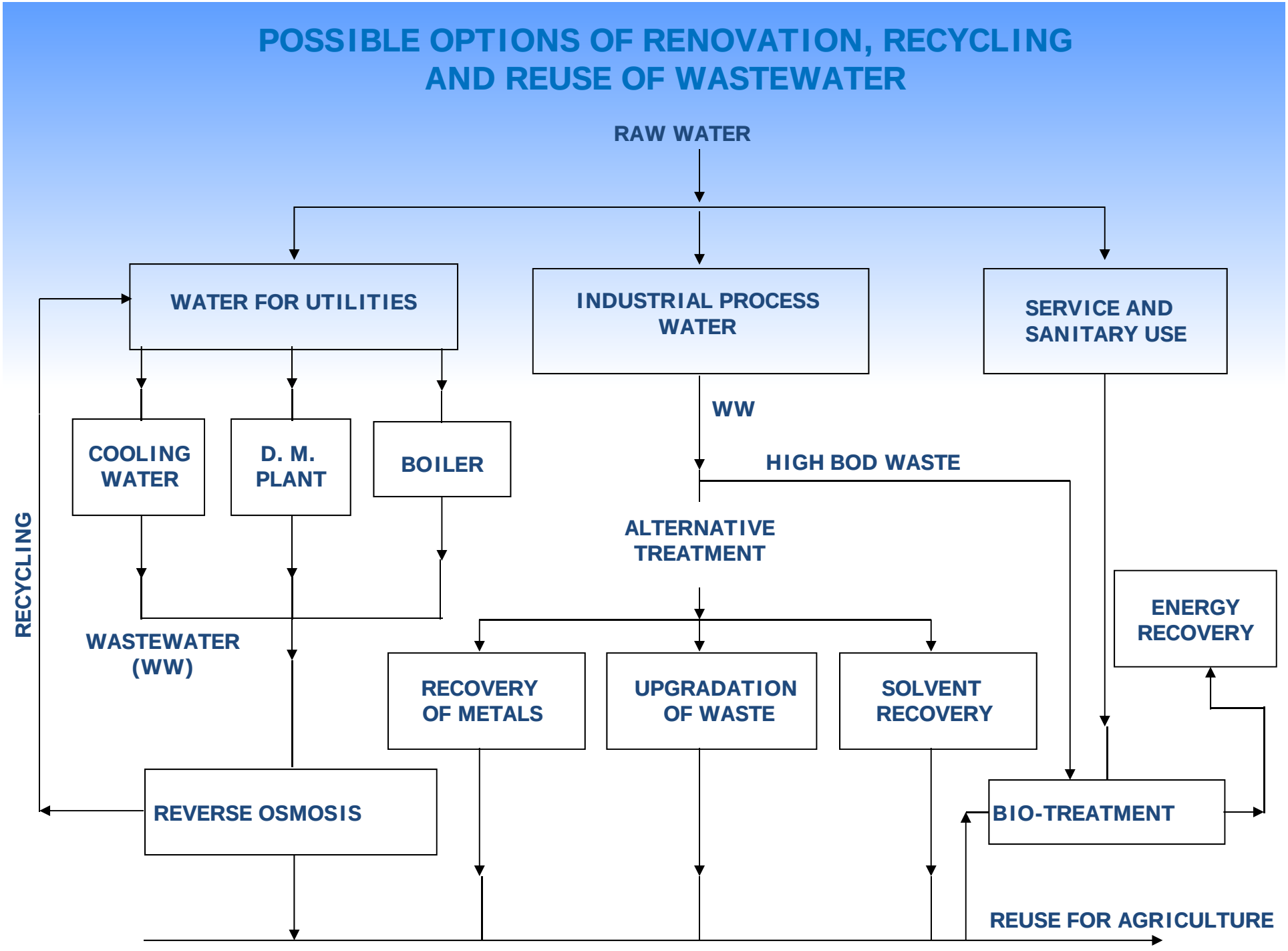
ISBL


UNIT OPERATION
FLOW (L/TON)
IN-SITU TREATMENT
Desalter
30-100
CPI
ADU+VDU
26
CPI/ Stripping
VC/TC
56
CPI/ Stripping
Cooking
25
Stripping
Catalytic cracking
60-90
Stripping
Catalytic Hydrocracking
26
Stripping
Alkylation
Isomerisation
Catalytic Refining
Gas Treatment
Dewaxing/solvent
Solvent recovery
Heat exchanger
Blow down
CPI


OSBL
Flocculant
Composition of Combined Water
API/PPI
DAF/TAF
Sludge
OIL SKIMMER
Oil recovery
AERATION
CLARIFIER
SBR
FILTERATION
UF
RO
Recycle for CW / Boiler makeup
RO Reject

Treated Effluent Option of Renovation, Recycling and Reuse.

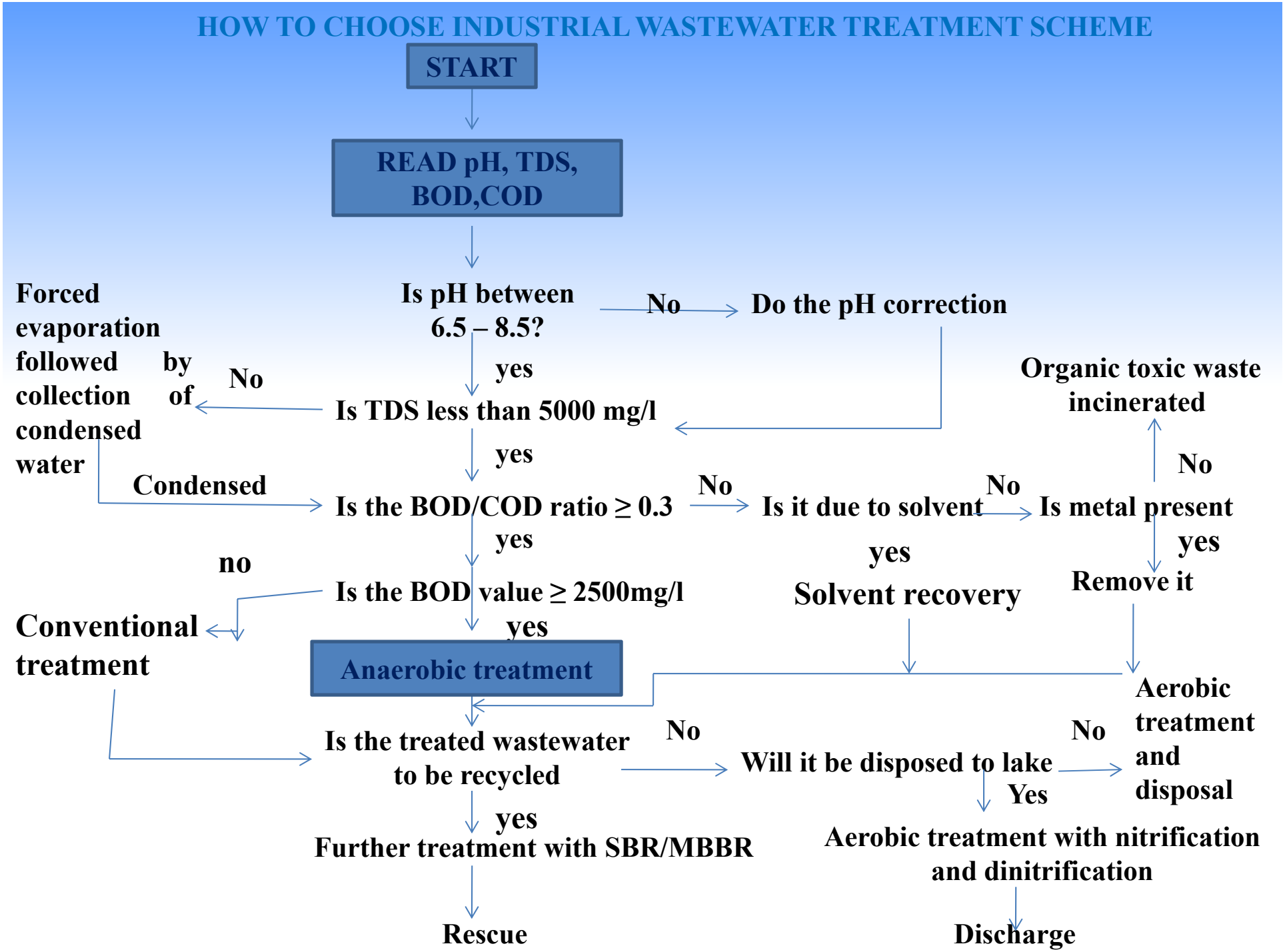
POSSIBLE OPTIONS OF RENOVATION, RECYCLING AND REUSE OF WASTEWATER



Best Management System

- Reuse of condensate water which has low minerals content and typically is generated in good amount when cooling tower load is high.
- Reuse and Recycle of treated effluent after appropriated treatment.
- Use softening plant to reduce total dissolved solids in makeup water.
- Use Treated Sewage as makeup water
- Install real time conductivity measurement to both raw water, makeup and blowdown water.
- Check and maintenance basin leaks or overflow
- Avoid ground water source as cooling tower makeup.

HOW TO CHOOSE INDUSTRIAL WASTEWATER TREATMENT SCHEME



What will be the appropriate treatment?

Problem no 1

If pH -5.5, BOD – 3000mg/l, COD – 5000 mg/l,
BOD-COD ratio – 0.6, SS – 100 mg/l

Problem no 2

If pH -6.5, BOD – 600mg/l, COD – 1000 mg/l,
BOD-COD ratio – 0.6, SS – 200 mg/l

Problem no 3

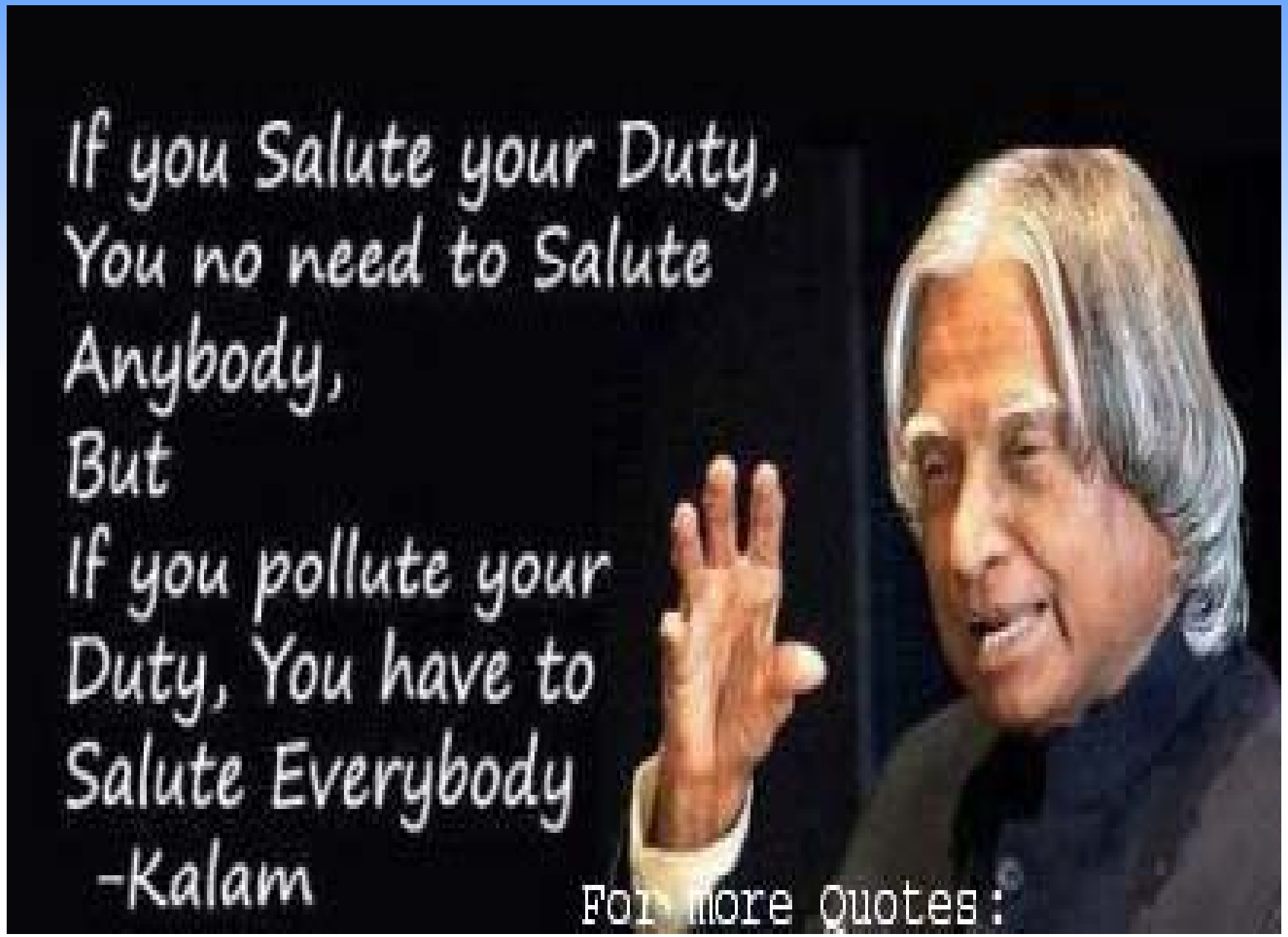
If pH -7.5, BOD – 1000mg/l, oil and grease – 100mg/l,
COD – 3000 mg/l, SS – 200 mg/l

Problem no 4

If pH -8.00, BOD – 200mg/l, COD – 3000 mg/l

Problem no 5

If pH -6.5 -8.5, BOD – 250mg/l, COD – 500 mg/l,
SS – 150 mg/l.


If you Salute your Duty,
You no need to Salute
Anybody,
But
If you pollute your
Duty, You have to
Salute Everybody
-Kalam
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THANK YOU!