Pollution from Detergents & Dyes

WHAT IS A DETERGENT?

- A detergent is a surfactant or a mixture of surfactants with cleansing properties in dilute solutions.
- Detergents are the sodium or potassium salts of long chain benzene sulphonic acids.

TYPES OF DETERGENTS

- There are two types of detergents:
  - Soapless detergents (or synthetic detergents)
  - Soapy detergents (or soaps)



Soapless



Soapy

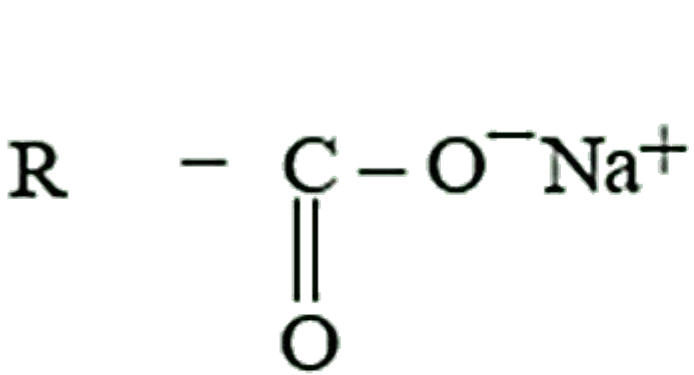
Soap less detergents

- They are also known as synthetic detergents.
- Soapless detergent is a synthetic cleansing agent distilled from petroleum-based and oil/fat-based substances.
- Its chemical composition prevents the formation of soap scum when combined with hard water.

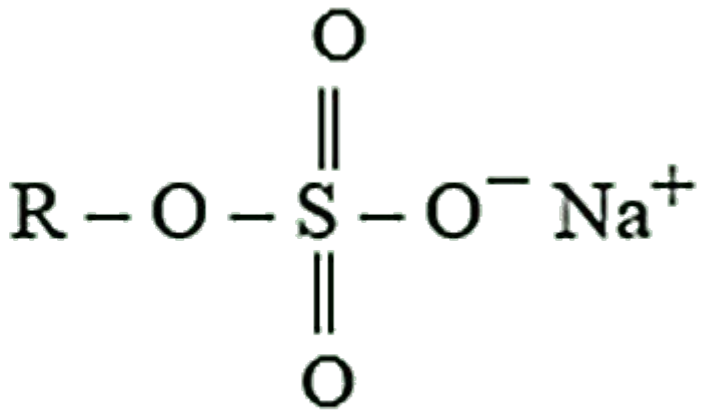
Soapy detergents

- They are commonly known as soaps.
- They are metal salts of long chain higher fatty acids.
- They are prepared from vegetable oils & animal fats.
- They cannot be used effectively in hard water due to the formation of scum i.e. insoluble precipitates of Ca^{2+}, Mg^{2+}, Fe^{2+} etc.

	Soap	Detergents
(i)	Soaps are sodium salts of long chain carboxylic acids.	Detergents are sodium salt of long chain benzene sulphonic acids.
(ii)	The ionic group in soap is $COONa^+$	The ionic groups in detergents is SO_3^-, Na^+
(iii)	Soaps are not useful when water is hard.	Detergent can be used for washing purpose even when water is hard.
(iv)	Soaps are biodegradable.	Some of the detergents are non- biodegradable.
(v)	Soaps have relatively weak cleansing action.	Detergents have strong cleansing action.



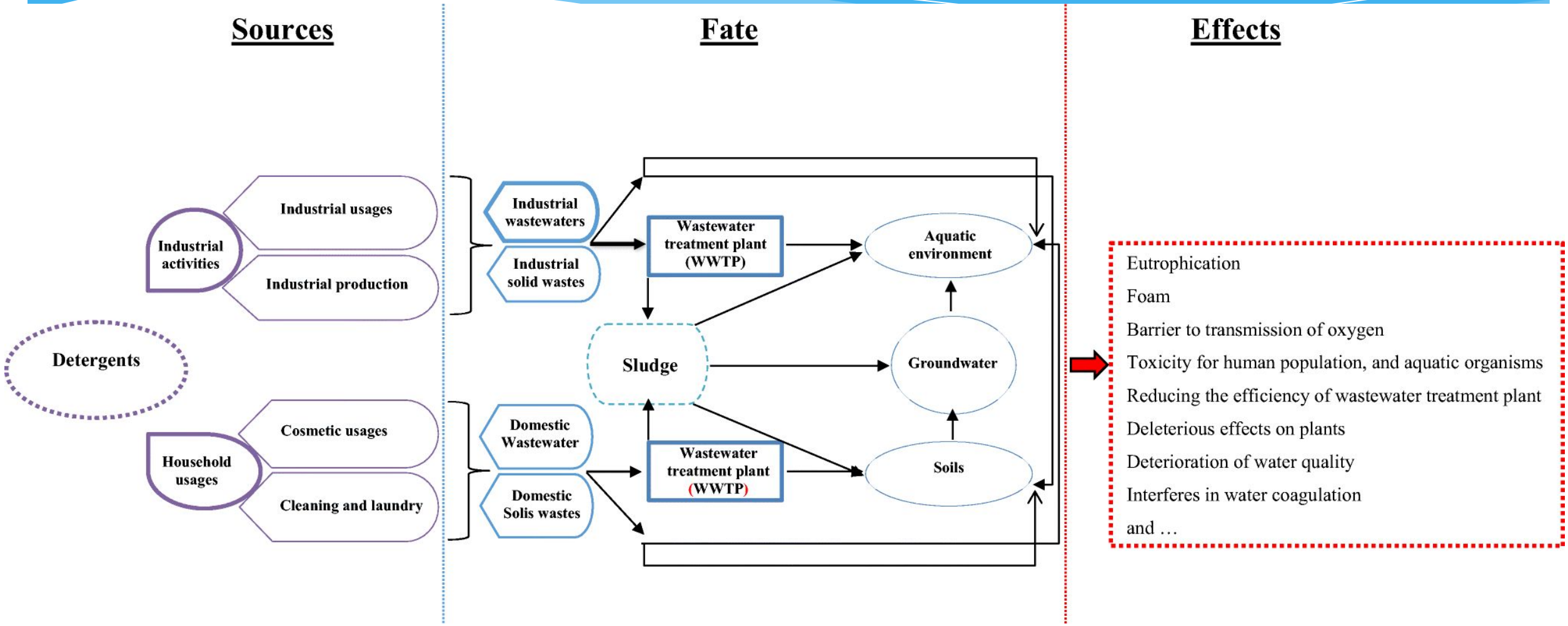
(Soap)



(Detergent)

What do we use them for?

- Detergents are very widely used in both **industrial** and domestic premises like soaps and detergents to wash vehicles.
- They are also used in pesticide formulations and for dispersing oil spills at sea.
- The major entry point into water is via sewage works into surface water.



Sources, distribution, and effects of detergents in the environment



What occurs if detergents show up in freshwaters?

- Detergents can have **poisonous effects** in all types of aquatic life if they are present in sufficient quantities, and this includes the biodegradable detergents.
- Detergent **destroy the external mucus layers** that protect the fish from bacteria and parasites; plus they can cause **severe damage to the gills**.
- Most fish will die when detergent concentrations approach **15 parts per million**.
- concentrations as low **as 5 ppm** will kill fish eggs. Surfactant detergents are implicated in decreasing the breeding ability of aquatic organisms.

What occurs if detergents show up in freshwaters?

- Detergents also add another problem for aquatic life **by lowering the surface tension** of the water. Organic chemicals such as pesticides and phenols are then much more easily absorbed by the fish. A detergent concentration of only 2 ppm can cause fish to absorb double the amount of chemicals they would normally absorb, although that concentration itself is not high enough to affect fish directly.

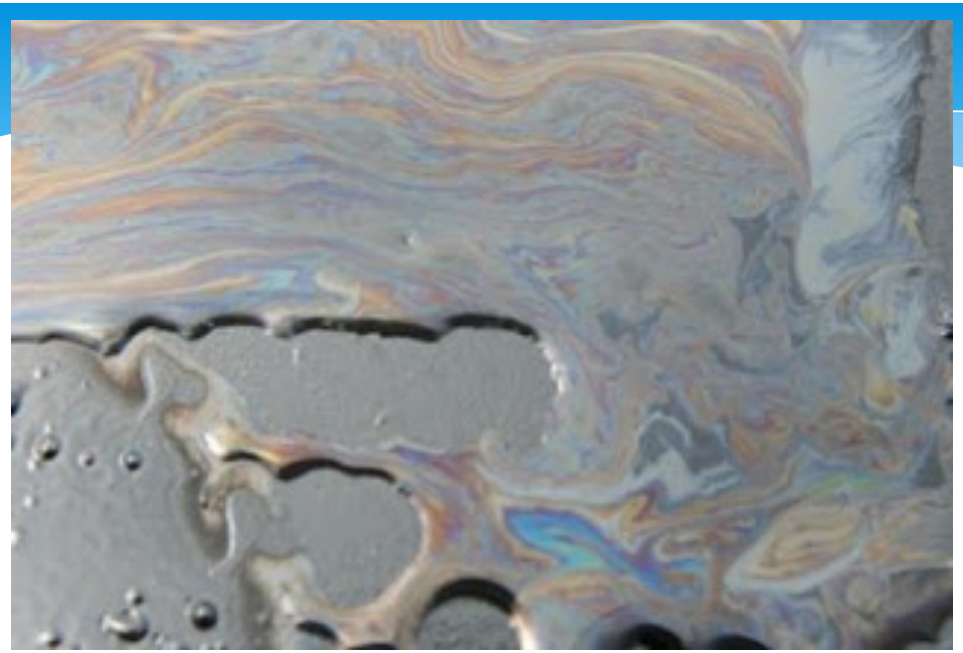
What occurs if detergents show up in freshwaters?

- Phosphates in detergents can lead to freshwater algal blooms that releases toxins and deplete oxygen in waterways. When the algae decompose, they use up the oxygen available for aquatic life.

What is a Dye?

A natural or synthetic substance used to add a color or change the color of something. Such substances with considerable coloring capacity are widely employed in the production of consumer products, including paints, textile, printing inks, pharmaceutical, food, cosmetics, plastics, photographic and paper industries.

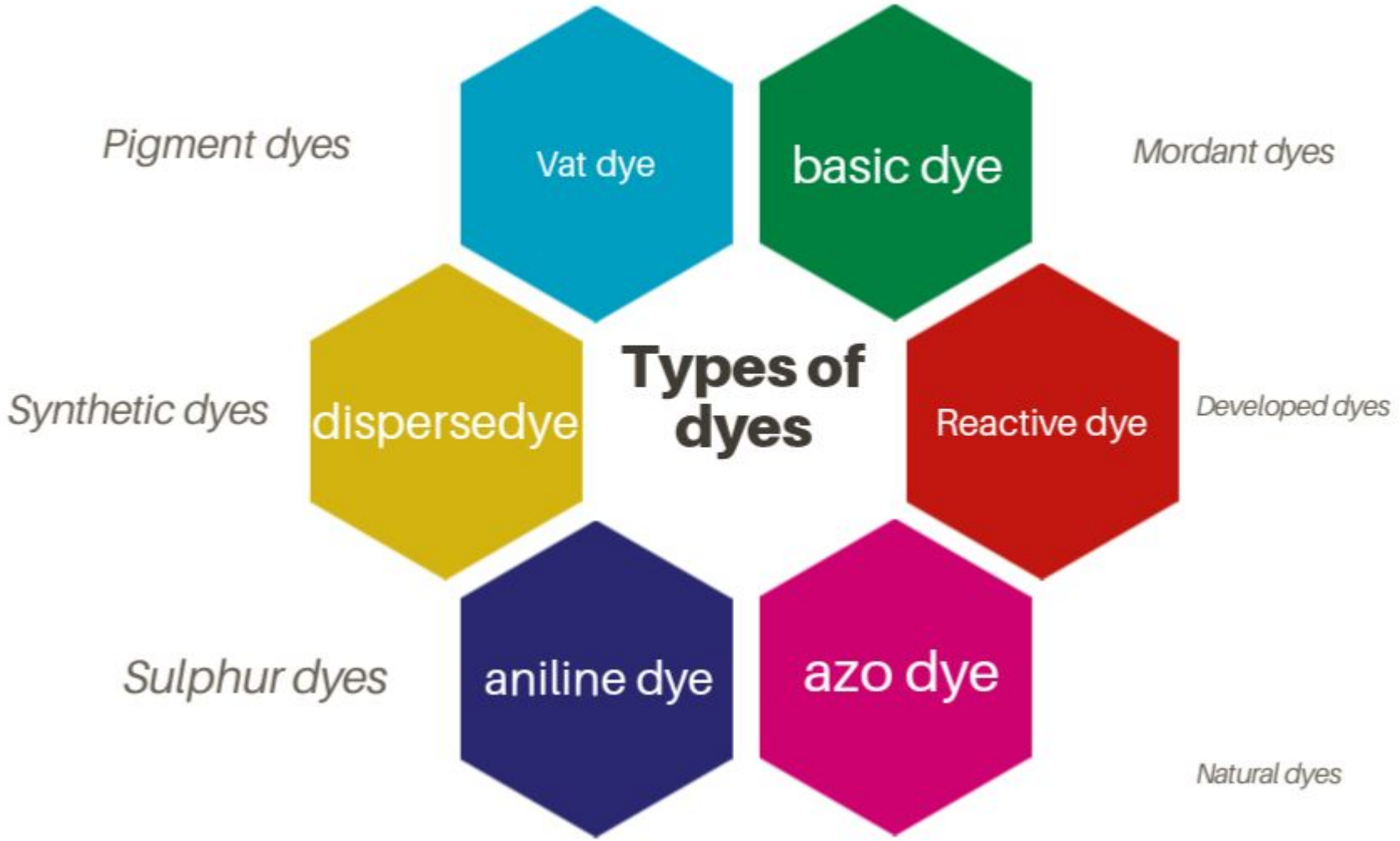






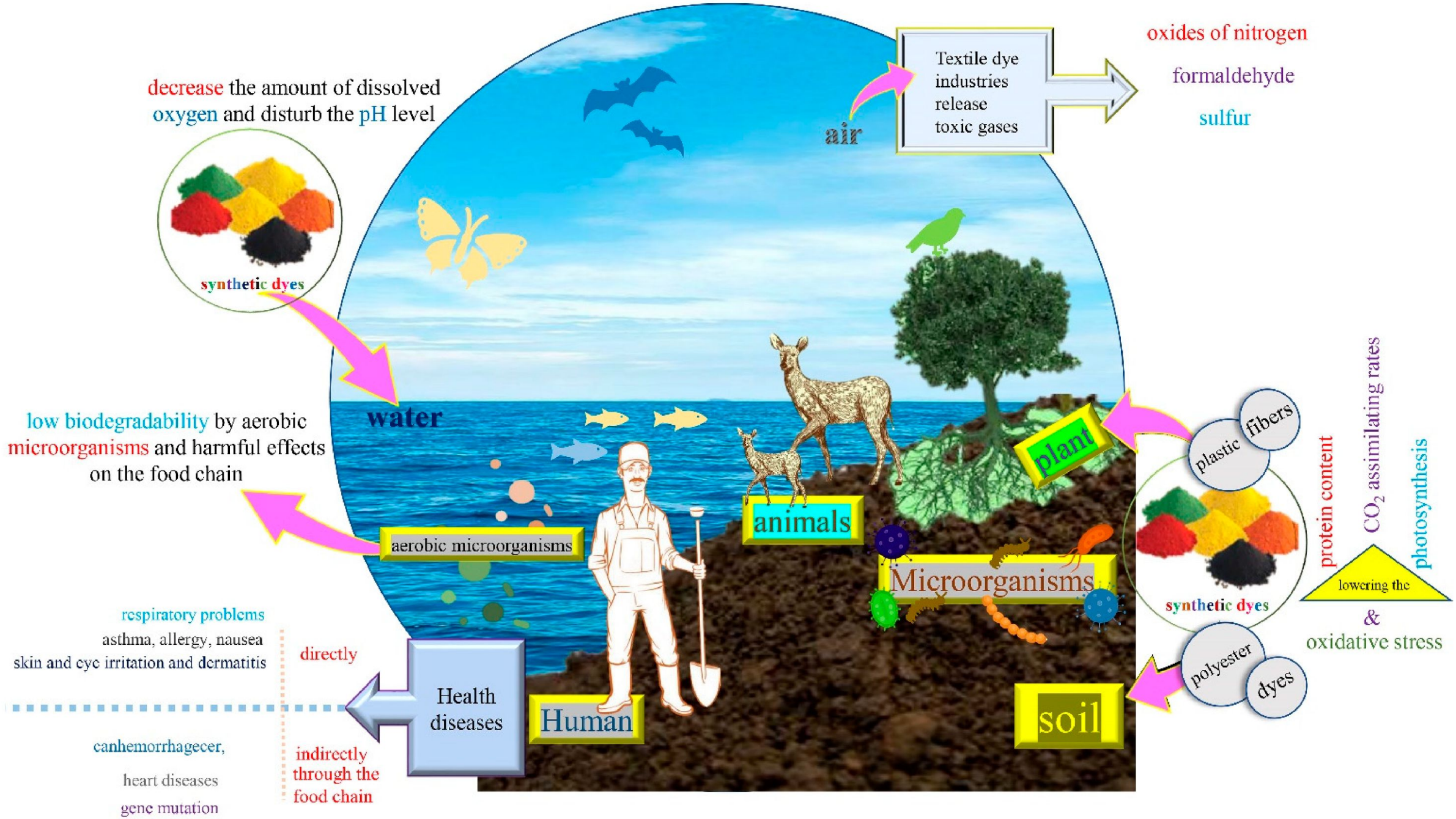





Types of dyes
Pigment dyes
Vat dye
basic dye
Mordant dyes
Synthetic dyes
dispersedye
Reactive dye
Developed dyes
Sulphur dyes
aniline dye
azo dye
Natural dyes

The main pollutants and concentration from textile industry

Parameters	Values
pH	7.0– 9.0
Biochemical Oxygen Demand (mg/L)	80 – 6.000
Chemical Oxygen Demand (mg/L)	150 – 12.000
Total Suspended Solids (mg/L)	15 – 8.000
Total Dissolved Solids (mg/L)	2.900 -3.100
Chloride (mg/L)	1000 – 1600
Total Kjeldahl Nitrogen (mg/L)	70 – 80
Colour (Pt-Co)	50-2500


decrease the amount of dissolved oxygen and disturb the pH level
synthetic dyes
air
Textile dye industries release toxic gases
oxides of nitrogen
formaldehyde
sulfur
water
low biodegradability by aerobic microorganisms and harmful effects on the food chain
aerobic microorganisms
animals
plant
Microorganisms
plastic
fibers
synthetic dyes
protein content
CO_2 assimilating rates
photosynthesis
lowering the
&
oxidative stress
polyester
dyes
soil
Human
Health diseases
directly
respiratory problems
asthma, allergy, nausea
skin and eye irritation and dermatitis
indirectly through the food chain
canhemorrhagecer,
heart diseases
gene mutation

Impacts on Air

- ✔ Textile dye industries release toxic gases like sulfur, formaldehyde, oxides of nitrogen, volatile compounds, particulate matter and dusts distinguished by an unpleasant smell .

- ✔ This air pollution could affect humans (workers and customers), animals, the final product and the environment.

Impacts on Water

- ✔ The dark color and high turbidity of these effluents interfere with sunlight transmission through water, decrease the amount of dissolved oxygen and disturb the pH level.

- ✔ These factors lead to several ecological impacts on the aquatic system such as the inhibition of photosynthesis in aquatic plants, low biodegradability by aerobic microorganisms and harmful effects on the food chain.

- ✔ Water is highly susceptible to pollution compared to the other areas, and it is also hard to determine the pollution level in aquatic systems. The water may appear clear even though the pollution may reside for long periods in sediments and fish

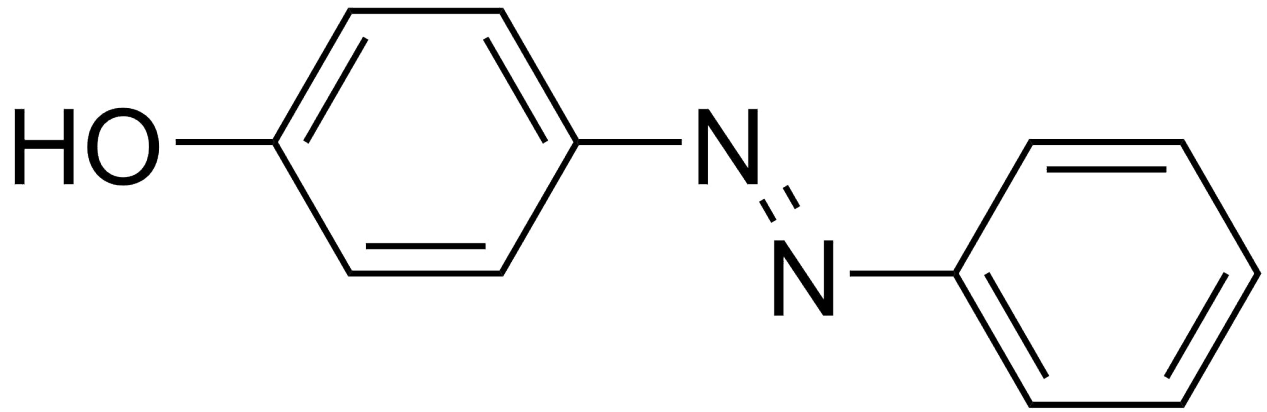
Impacts on Human

- ✔ Affect several vital organs (brain, kidney, liver, heart) and systems (respiratory, immune, reproductive) of the human organism .

- ✔ Diseases may occur either directly through inhalation such as respiratory problems, asthma, allergy, nausea, or skin and eye irritation and dermatitis, or indirectly through the food chain such as tuberculosis, cancer, hemorrhage, gene mutations, and heart disease

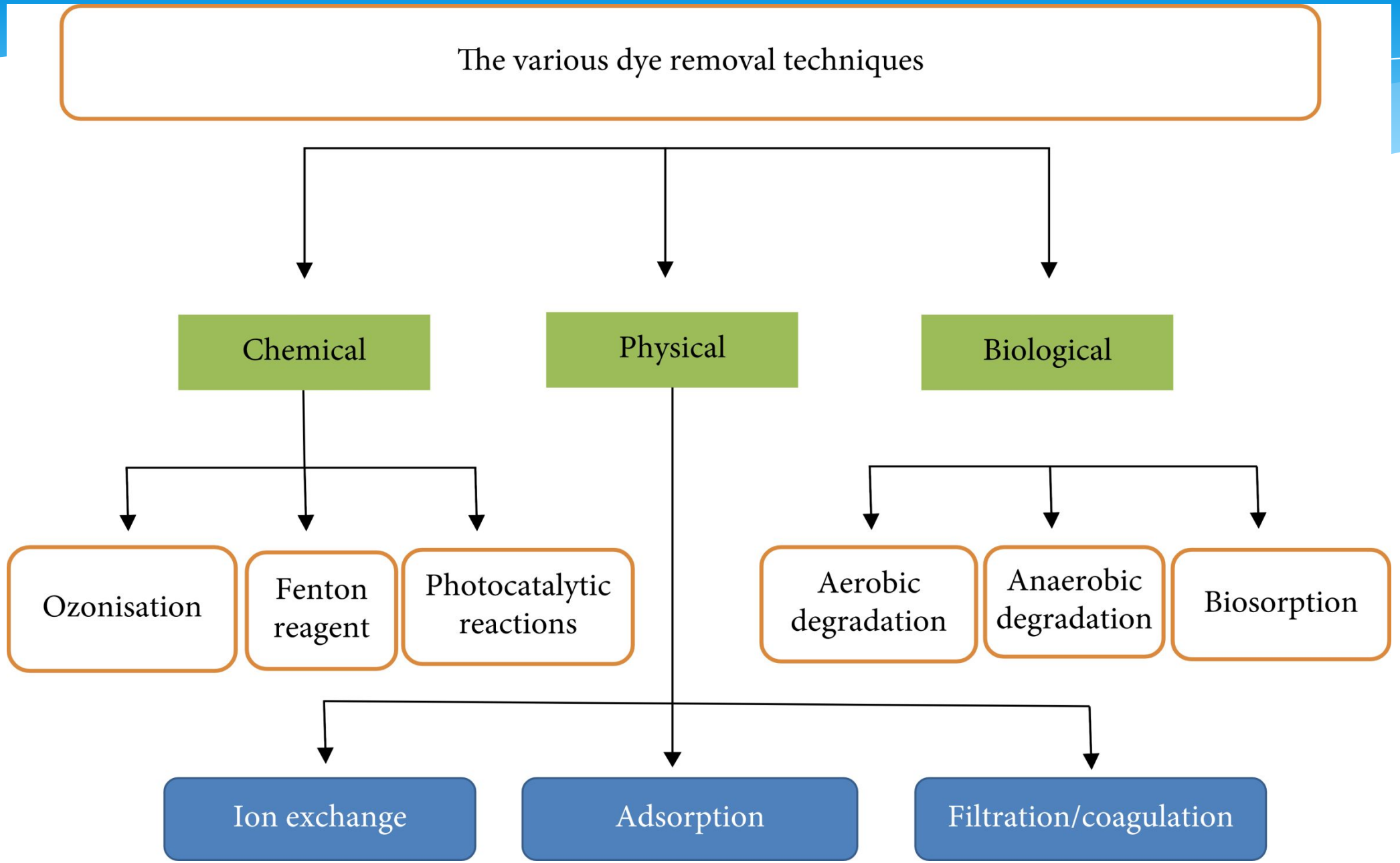
- Azo dyes have toxic effects, especially carcinogenic and mutagenic.
- They entering the body by ingestion and are metabolized by intestinal microorganisms causing DNA damage.





The parameters of water to be checked for pollution:

- ✓pH
- ✓Temperature
- ✓Alkalinity
- ✓Dissolved oxygen (DO)
- ✓Electrical conductivity
- ✓Total dissolved solids (TDS)
- ✓Total suspended solids (TSS)
- ✓Total hardness
- ✓Chemical oxygen demand (COD)
- ✓Total solids (TS)


The various dye removal techniques
Chemical
Physical
Biological
Ozonisation
Fenton reagent
Photocatalytic reactions
Aerobic degradation
Anaerobic degradation
Biosorption
Ion exchange
Adsorption
Filtration/coagulation



