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Sustainable GCC Environment
Challenge for Our Future

DISSOLVED AIR FLOTATION SYSTEM AS PRETREATMENT & PROTECTION FOR DESALINATION PLANTS

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Motivation for Sustainable Treatment

Increasing water and power demand in KSA.

Building new or extending existing water and power producing facilities.

The existing facilities need to operate in continuous and sustainable structure.

The Arabic Gulf is **shallow** with very **little mixing**.

Challenges: high turbidity, red tide algae bloom , Oil contamination.

DAF seawater pretreatment

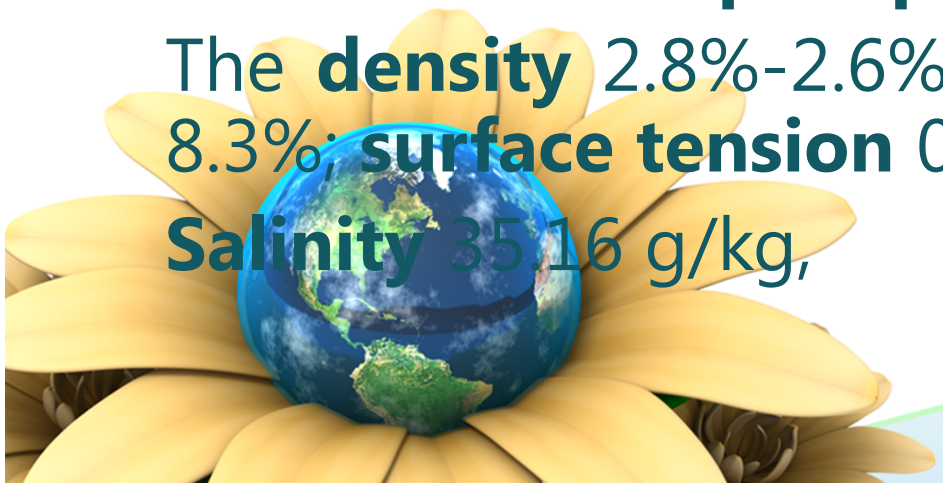
DAF is a gravity-driven solids–liquid separation process.

DAF is an emerging process for the clarification of seawater before desalination by reverse osmosis (SWRO).

The success of DAF depends the **movement of bubbles** and **particles** through water, and to the **dissolution** and **precipitation** of air.

The **density** 2.8%-2.6%; **dynamic viscosity** 6.3%-8.3%; **surface tension** 0.7%-1.4%.

Salinity 35.16 g/kg,



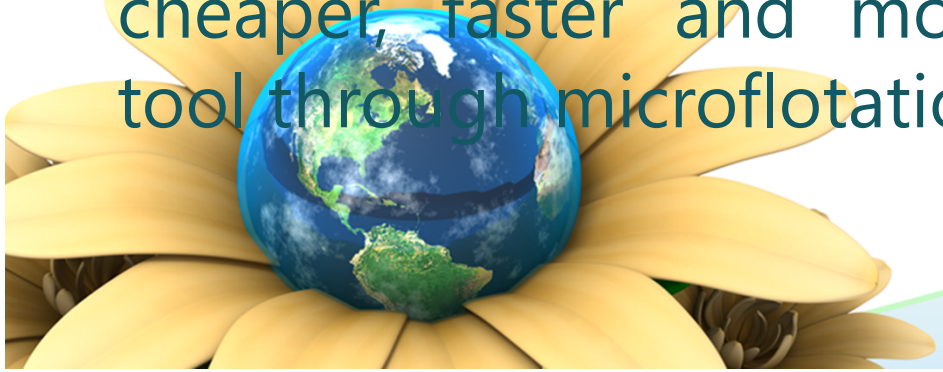
DAF and microflotation

Pumping liquid consumes a 1000 times more energy than pumping gas due to density difference .

Over 75% of surface water in the UK is now classified as **eutrophic**.

Management costs are estimated to be £75-114 million per year.

The major impact of DAF utilization is to provide a cheaper, faster and more effective remediation tool through microflotation technology.



Sea water desalination challenges

MWW effluents from coastal cities, villages and resort areas are often discharged directly or indirectly to the sea without treatment, causing **enrichment** (P & N) and **eutrophication** in coastal waters.

Currently sewerage system covers **42%** of the urban areas in KSA.

About **1460 MCM** of WW is generated in KSA

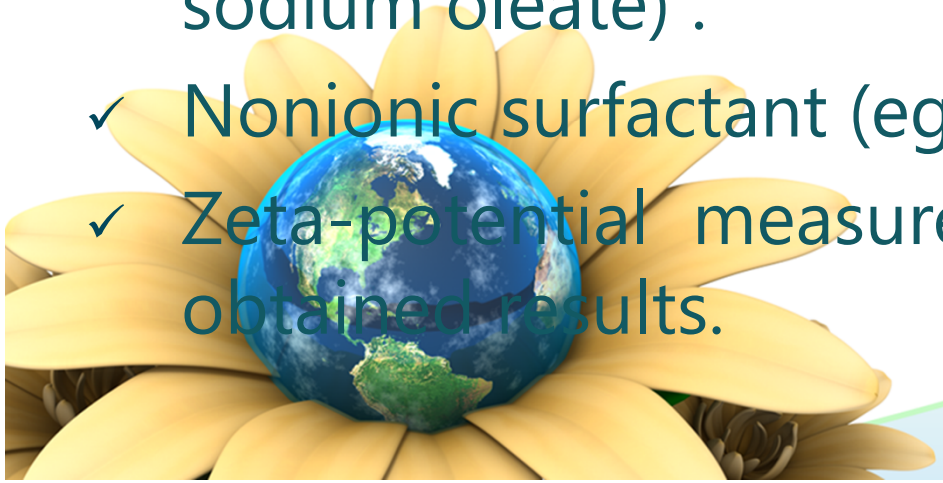
Only **671 MCM** is treated (about **47 %**).

Rivers in Iran and Iraq carry 500,000 m3/d of wastewater to the Gulf (UNEP 2001).

Parameters under investigation

Effect parameters on flotation efficiency:

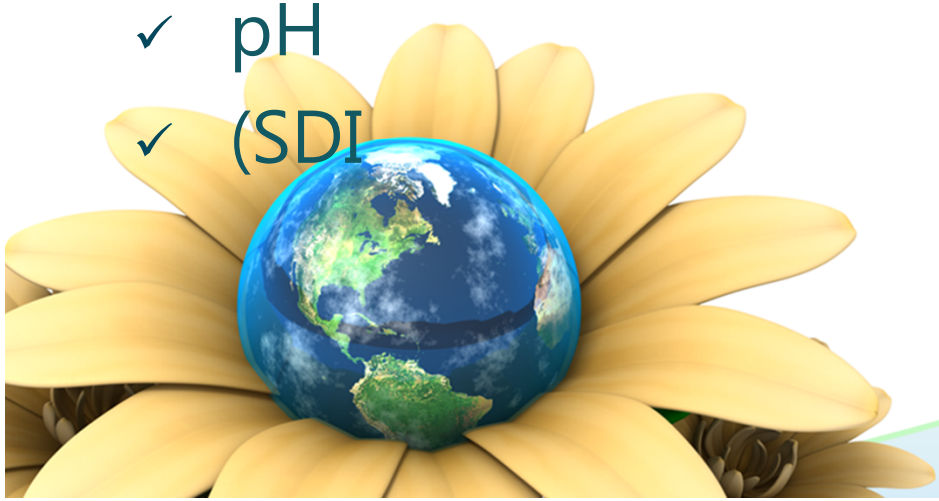
- ✓ Initial pH value of the emulsions.
- ✓ Concentration polyelectrolytes (organic flocculants of cationic or anionic type) or ferric chloride (inorganic coagulant).
- ✓ The recycle ratio.
- ✓ Concentration of flotation collector (used as sodium oleate) .
- ✓ Nonionic surfactant (eg Tween 80).
- ✓ Zeta-potential measurements to interpret the obtained results.



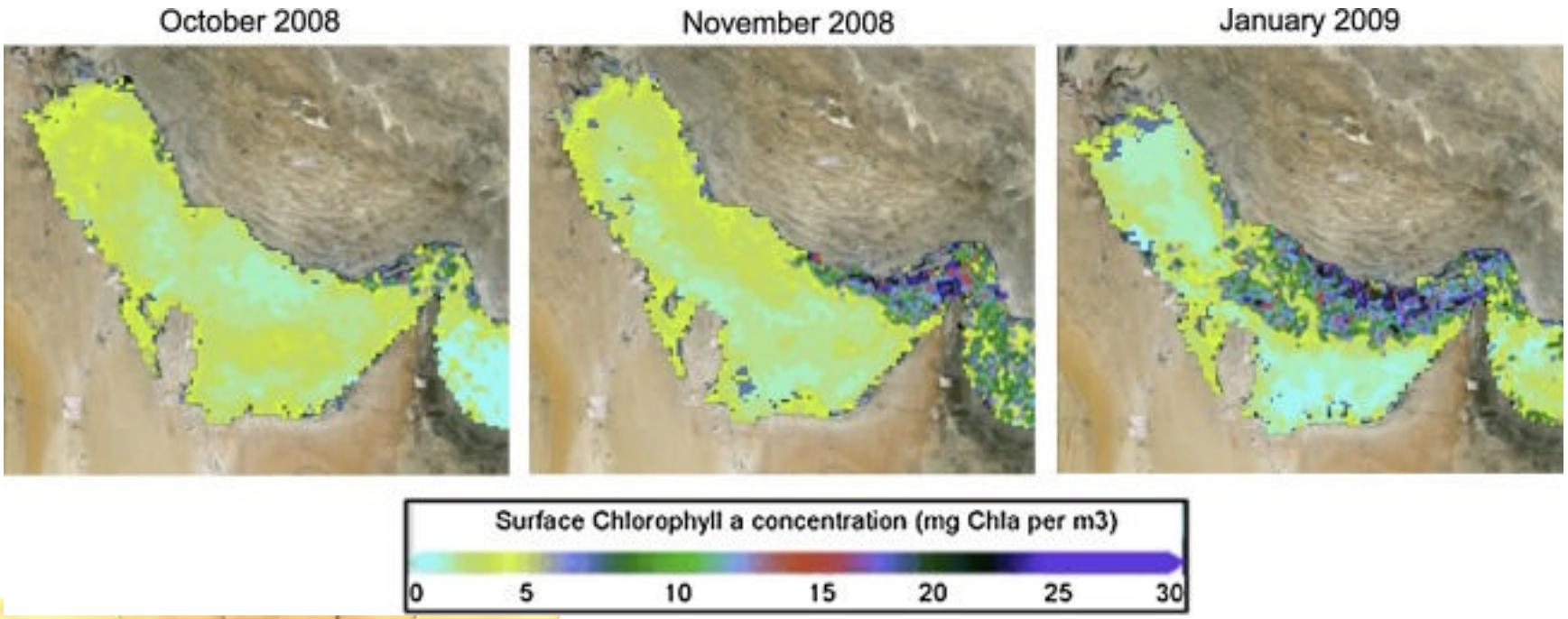
DAF system performance

The performance of the DAF system will be inspected by measuring:

- ✓ Turbidity
- ✓ suspended solid
- ✓ TOC
- ✓ DOC
- ✓ pH
- ✓ (SDI



Harmful algal bloom in the Gulf.



http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3357718/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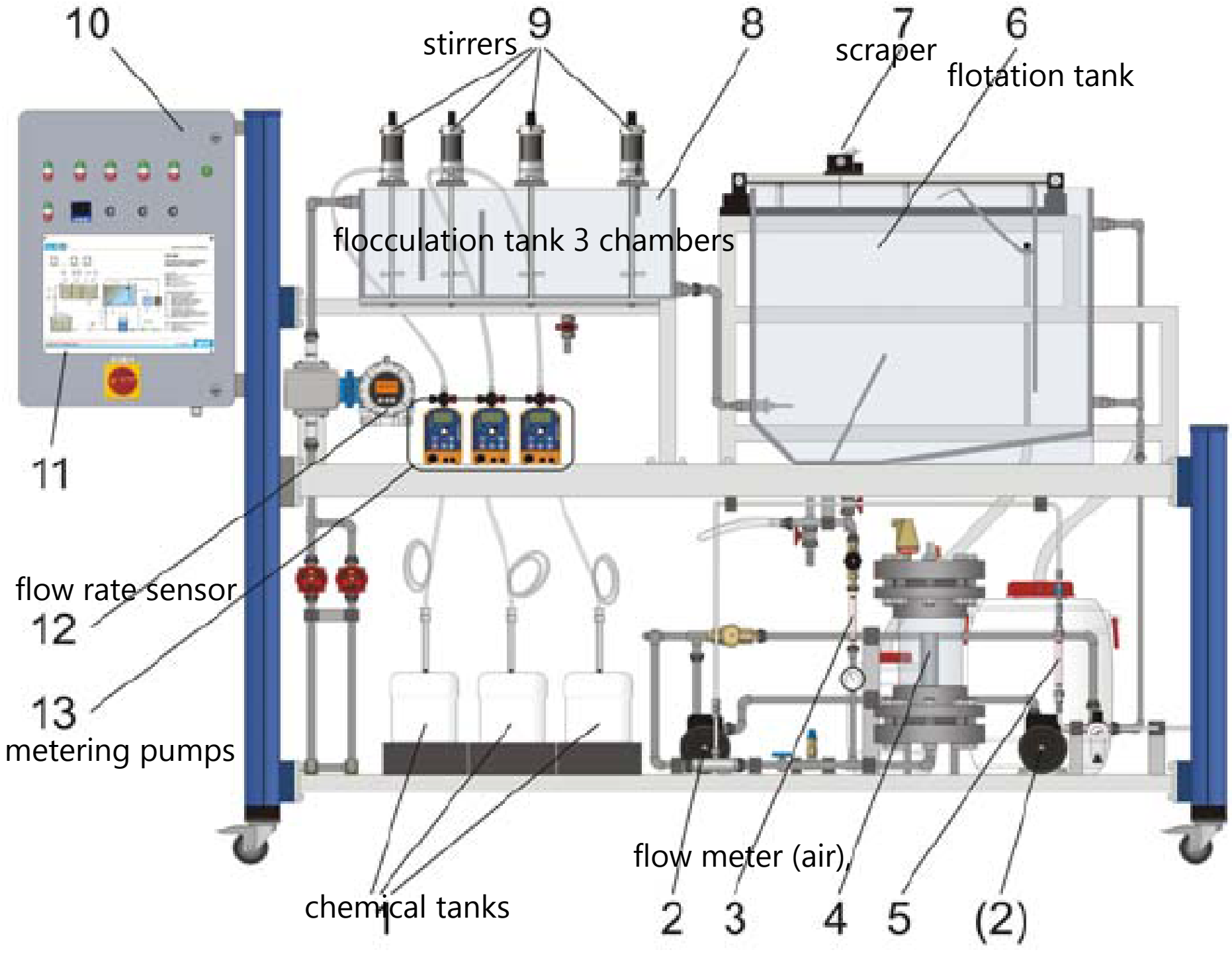
Precipitation and Flocculation

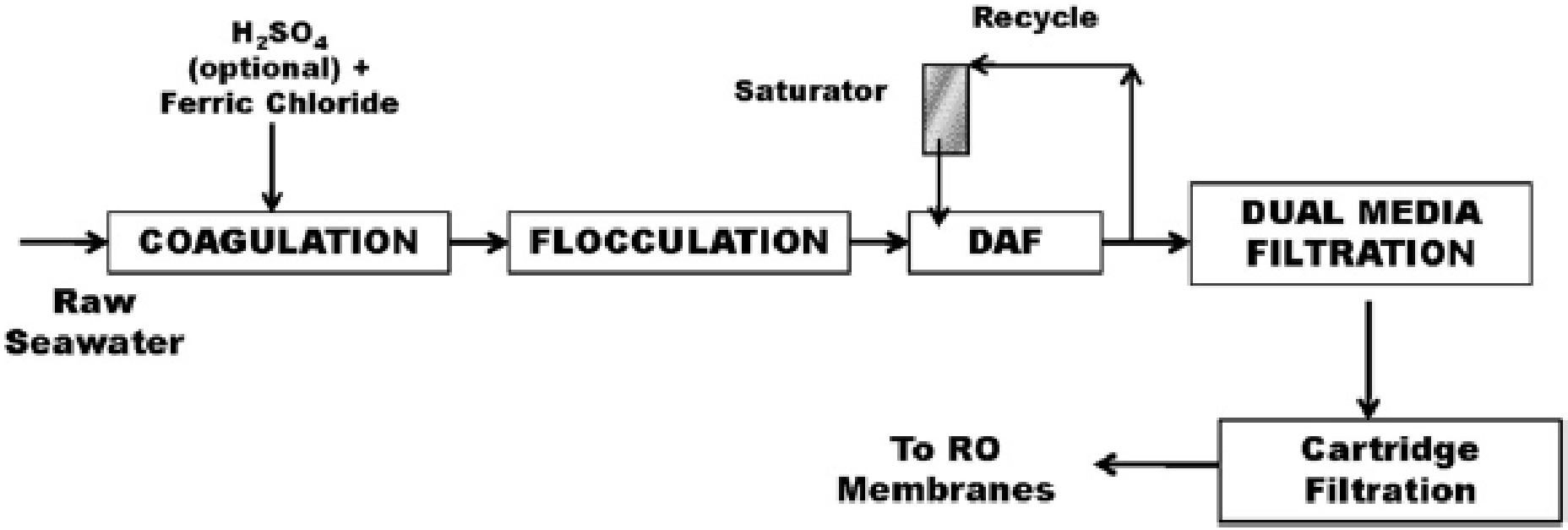
DAF system

- functional principle of dissolved air flotation
- creation of a stable operating state
- effects of various parameters
  * coagulant concentration
  * flocculant concentration
- determination of the hydraulic loading rate


10
stirrers
9
8
7
scraper
6
flotation tank
flocculation tank 3 chambers
11
flow rate sensor
12
13
metering pumps
chemical tanks
1
flow meter (air),
2
3
4
5
(2)

DAF Process pretreatment for SWRO plants.

$$\eta_D = 6.18\left[\frac{k_b T}{g(\rho_w - \rho_b)}\right]^{2/3}\left[\frac{1}{d_p}\right]^{2/3}\left[\frac{1}{d_b}\right]^{2}$$

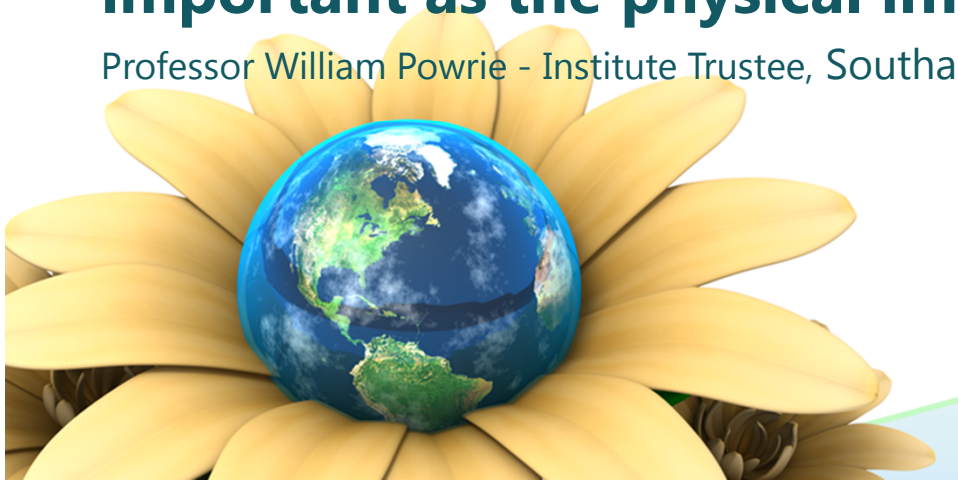


Sustainability and Water Treatment

In 1987, the United Nations World Commission on Environment and Development UNWCED stated that sustainability is **"meeting the needs of the present without compromising the ability of future generations to meet their own needs."**

"Sustainability is not just about technology: **the way we behave as individuals and as a society are at least as important as the physical infrastructure we build and use**."

Professor William Powrie - Institute Trustee, Southampton university



Life Cycle Thinking in SWM

The European Commission's Strategy on the Prevention and Recycling of Waste emphasis on: **Life Cycle Thinking** is essential in the move towards more **sustainable consumption** and **production**.

Life cycle assessment (**LCA**) is a widely used and internationally standardized (**ISO14040**) **methodology** that helps to **quantitatively** support **life cycle thinking**.

Life Cycle Assessment (LCA)

LCA is a **tool** that facilitates life cycle thinking (**LCT**) when comparing **options** for different **products**.

LCA provides **insights** that compliment those of many **regulatory-** and more site- or process-oriented **risk** and **impact assessments**.

All stages in a product's life cycle can result in the **generation** of **wastes**, **emissions**, and in **resource consumption**.

Life Cycle Inventory (LCI)

LCI is the **methodology** for **estimating** the **consumption** of **resources**, the **quantities** of **wastes**, the **emissions**, the **traffic accidents**, etc., that are associated with each **stage** in the life cycle of a product.

The **material** and **energy** flows are modelled between the various processes within the life cycle.

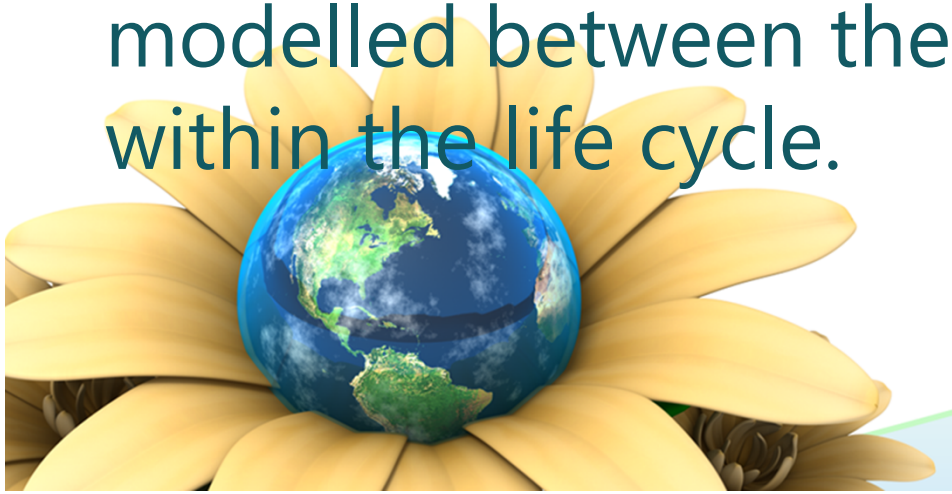
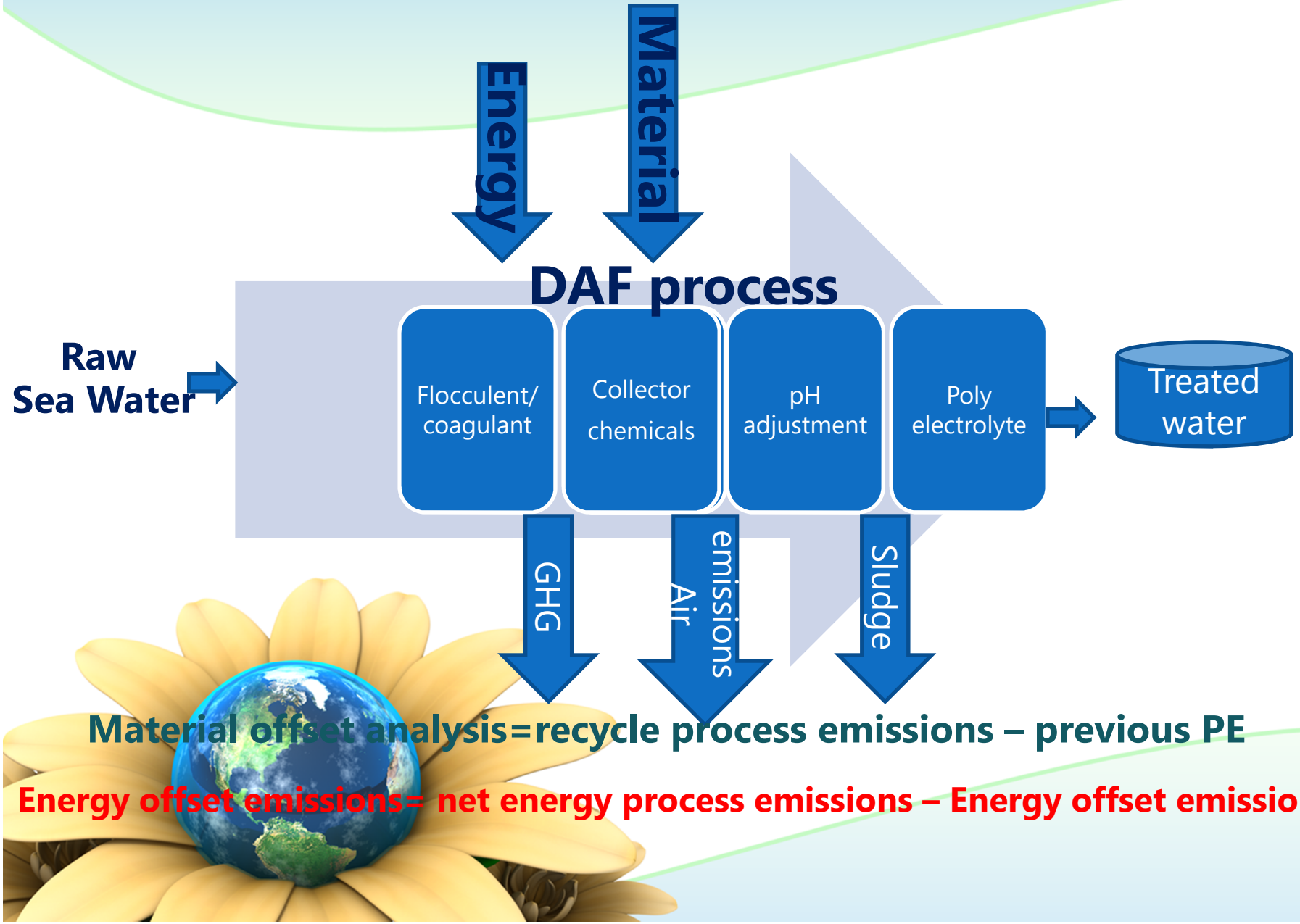


Diagram flow of Materials in DAF



Material offset analysis=recycle process emissions – previous PE

Energy offset emissions= net energy process emissions – Energy offset emissions

Advantages of DAF

- Small footprint , compact and robust.
- Flexible, can handle a reasonable variation in influent water quality.
- Optimum use of coagulants and flocculants, low operating cost.
- Easy to operate, service and clean.
- Can deal with red tide, algae bloom, oil spills, turbidity removal efficiency 95%.
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دمتم برعاية الله وحفظه