

AUS Repository

Water Treatment using Nanotechnology

| | |
|---------------|---|
| Item Type | Project |
| Authors | Salah, Halima;Soares, Ilda;Gandhi, Poojaben;Mir, Raza |
| Download date | 2026-03-07 06:16:15 |
| Link to Item | http://hdl.handle.net/11073/7701 |

CONVENTIONAL WATER TREATMENT PROCESSES

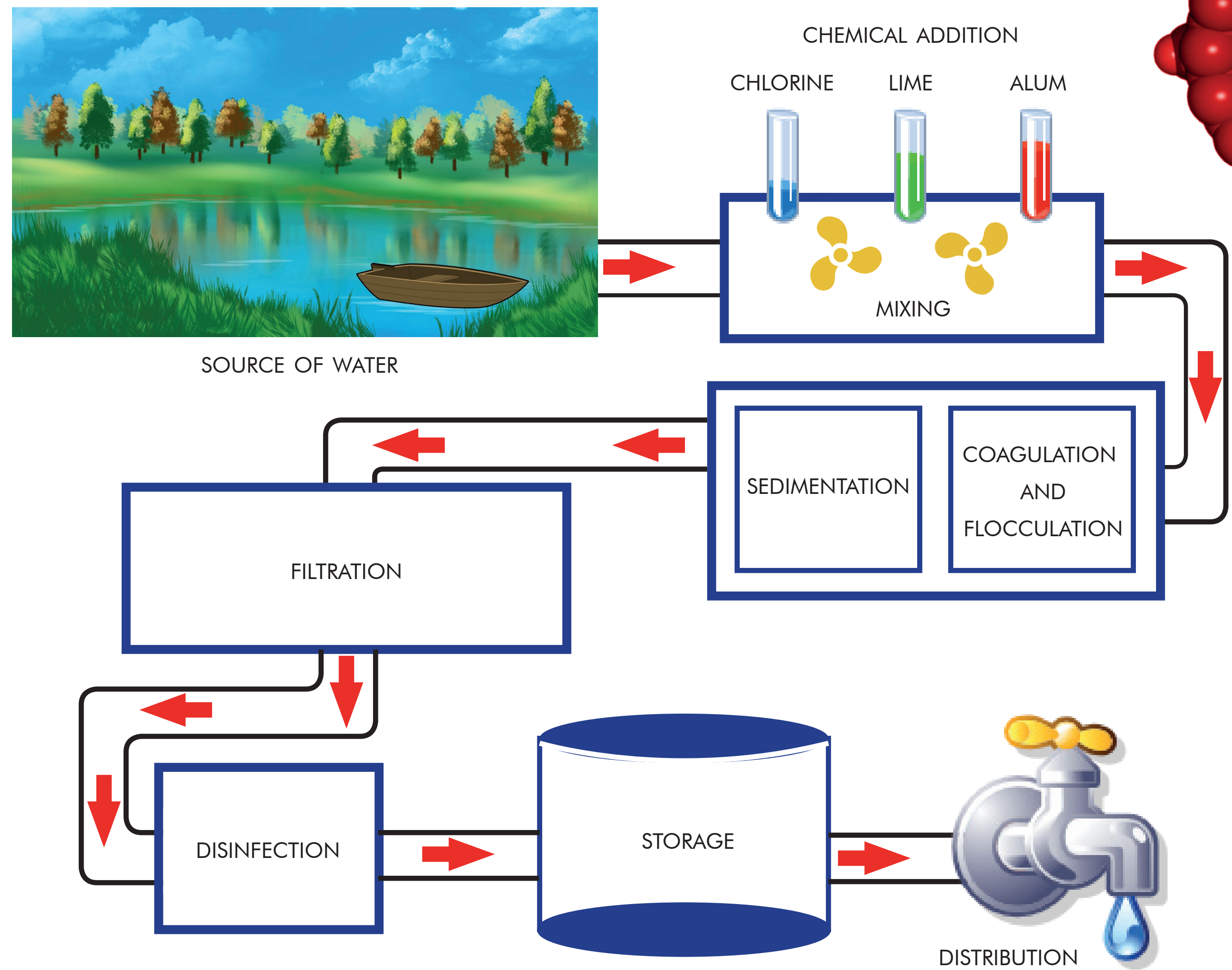


Figure 1: Water Treatment Process

Coagulation (Flocculation): Small particles are made into larger particles so that they can easily settle as sediment and be removed from the water.
Filtration: Process in which particles such as clays, silts, precipitates, iron and microorganisms are removed.
Disinfection: Process in which microbes, pathogens and microorganisms are killed by adding chlorine or ozone [5].

Why is the conventional water treatment process ineffective?

- Does not remove soluble substances
- Time consuming
- Energy wasteful
- Costly

NANOFILTRATION

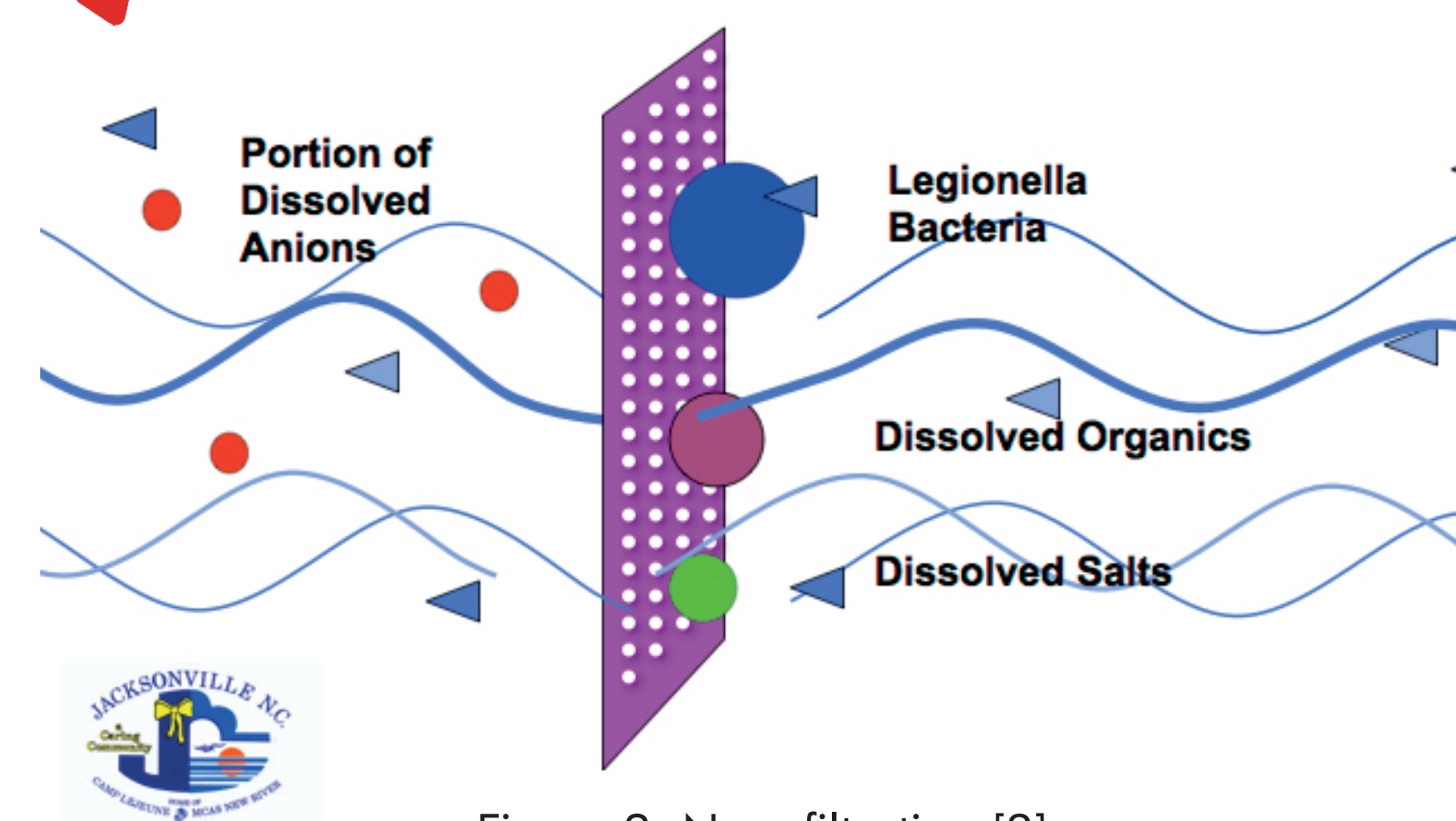
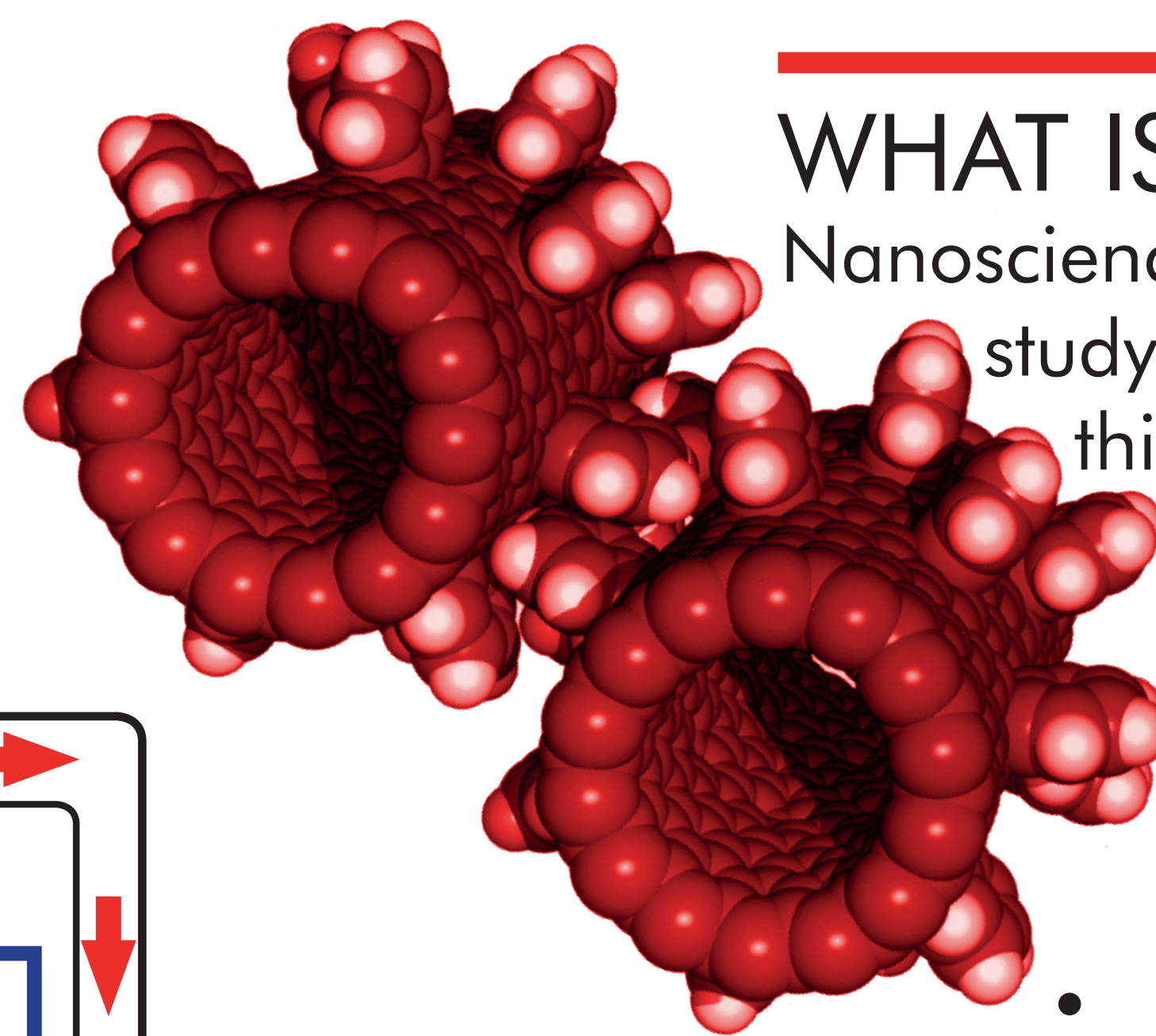
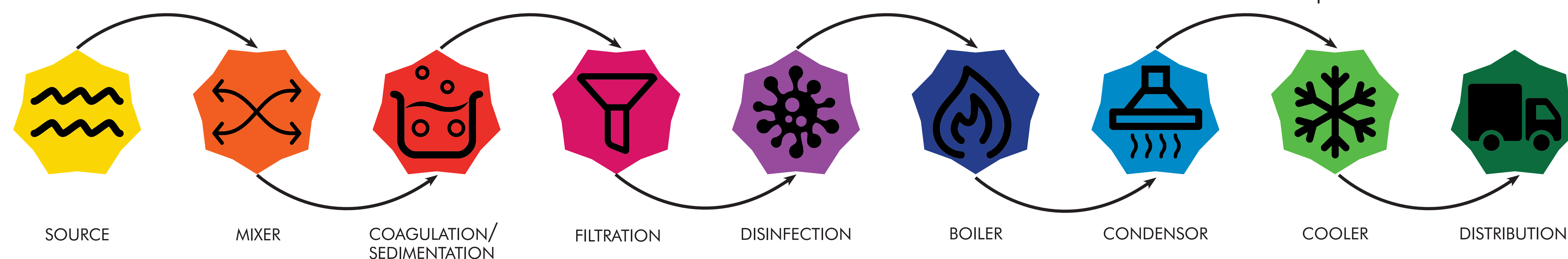


Figure 2: Nanofiltration [3]

Nanofiltration involves the use of semi-permeable membranes which selectively prevents soluble and minute substances from passing. This characteristic selectivity enables the preservation of nutrients present in the water that are required for the normal functioning of the human body [8].

PROCESS FLOW DIAGRAM



WHAT IS NANOTECHNOLOGY?

Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all science fields, such as chemistry, biology, physics, materials science, and engineering.

PROBLEM DEFINITION

- Designing an environmentally friendly water treatment plant which uses modern technology to treat water
- Identify conditions required to build this plant based on the harsh desert climate here in the UAE
- Make sure this plant works more efficiently and economically

WATER TREATMENT USING NANOTECHNOLOGY

HALIMA SALAH

ILDA SOARES

POOJABEN GANDHI

RAZA MIR

DESIGN CRITERIA

- Stainless steel is the proposed material to be used for pipes and tanks. It has a lifespan of 70-82 years and does not react with water or corrode easily [6]
- As a safety measure, a boiler may be introduced to evaporate harmful nanoparticles
- Pipes should be insulated to prevent heat loss and maintain a constant water temperature

NANOSENSORS

What are Chemical Nanosensors?

Chemical Nanosensors measure the presence of specific type of molecule or the molecular composition of a substance [1].

How do Nanosensors work?

Pathogen detection is the key process in the working of nanosensors [2].

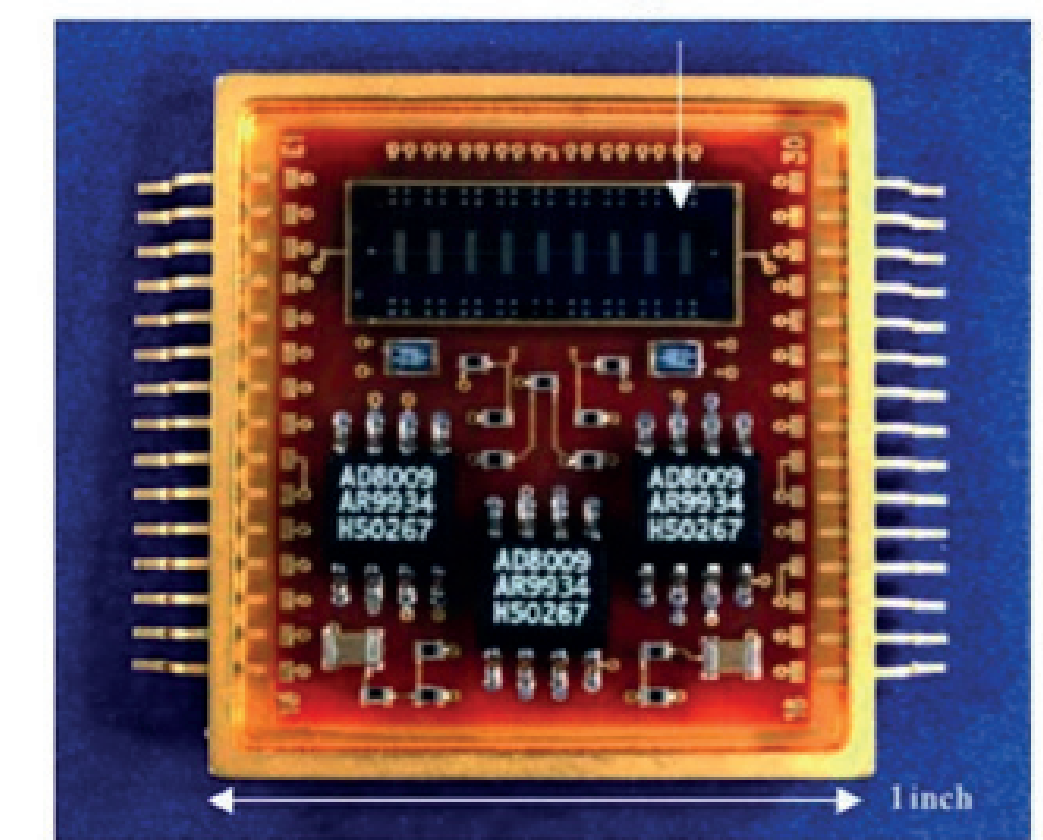


Figure 3: Nanosensor [7]

Nanosensors consist of 2 major components [2]:

RECOGNITION AGENTS

Recognition agents interact with antigens on the pathogen surface and decide whether the pathogen progresses to the next stage of the water treatment process.

NANOMATERIAL RELATED SIGNAL TRANSDUCTION

It is a process in which a signal is emitted by the molecules on the surface of the nanosensor to the receptor located inside. Pathogens are then recognized; this triggers a response such as disinfection.

What are some of the limitations of nanosensors?

Communication between the nanosensor nodes will be significantly affected if they need to recharge themselves before transmitting the data through the network. Energy needed for retransmission is expensive. There are limited resources for error correction.

ENVIRONMENTAL ASPECTS

An Environmental Impact Assessment needs to be carried out for the use of nanosensors in the water treatment. It is essential to assemble all the relevant information on the current status of the environment and this is called a Baseline Study.

Contaminants could be more effectively removed, even at low concentrations [4].

Nanotechnology could radically reduce the number of steps, materials and energy needed to purify water [4].

Nanotechnology and nanoparticles could eventually interact with human health and the environment and have unintended effects [4].

ADVANTAGES

DISADVANTAGES

REFERENCES

[1] B.Usibe, A. Menkiti, M. Onuu and J. Ogbulezie, "Development and analysis of a potential nanosensor communication network using carbon nanotubes," International Journal of Material Engineering, vol. 3, no. 1, pp. 4-10, 2013.
 [2] Q. Xiaolei, J.J. Pedro and Q.L. Alvarez, "Applications of nanotechnology in water and wastewater treatment," Water Research, vol. 47, no. 12, pp. 3931-3946, 2013.
 [3] "Nanofiltration", City Water Plant, [Online]. Available: <https://jacksonvillenc.gov/index.aspx?nid=246>
 [4] National Research Foundation, "Nanotechnology and water", Republic of South Africa: South African Agency for Science and Technology Advancement, n.d.
 [5] United States Environmental Protection Agency, "Drinking Water Treatment," EPA, USA, 1-3, 2004
 [6] Y. Kim, S. Park and H. Chang, "Lifespan estimation of seal welded super stainless steels for water condenser of nuclear power plants," Metals and Materials International, vol. 20, no. 1, pp. 69-76, 2014.
 [7] "Flexural Plate Wave Sensor", Nano Sensors Group, [Online]. Available: <http://nano.ece.illinois.edu/research/fpws.html>
 [8] A. F. Batisha, "Sustainability of water purification based on nanotechnology," International Journal of Sustainability, vol. 2, no. 1, pp. 14-17, 2013.