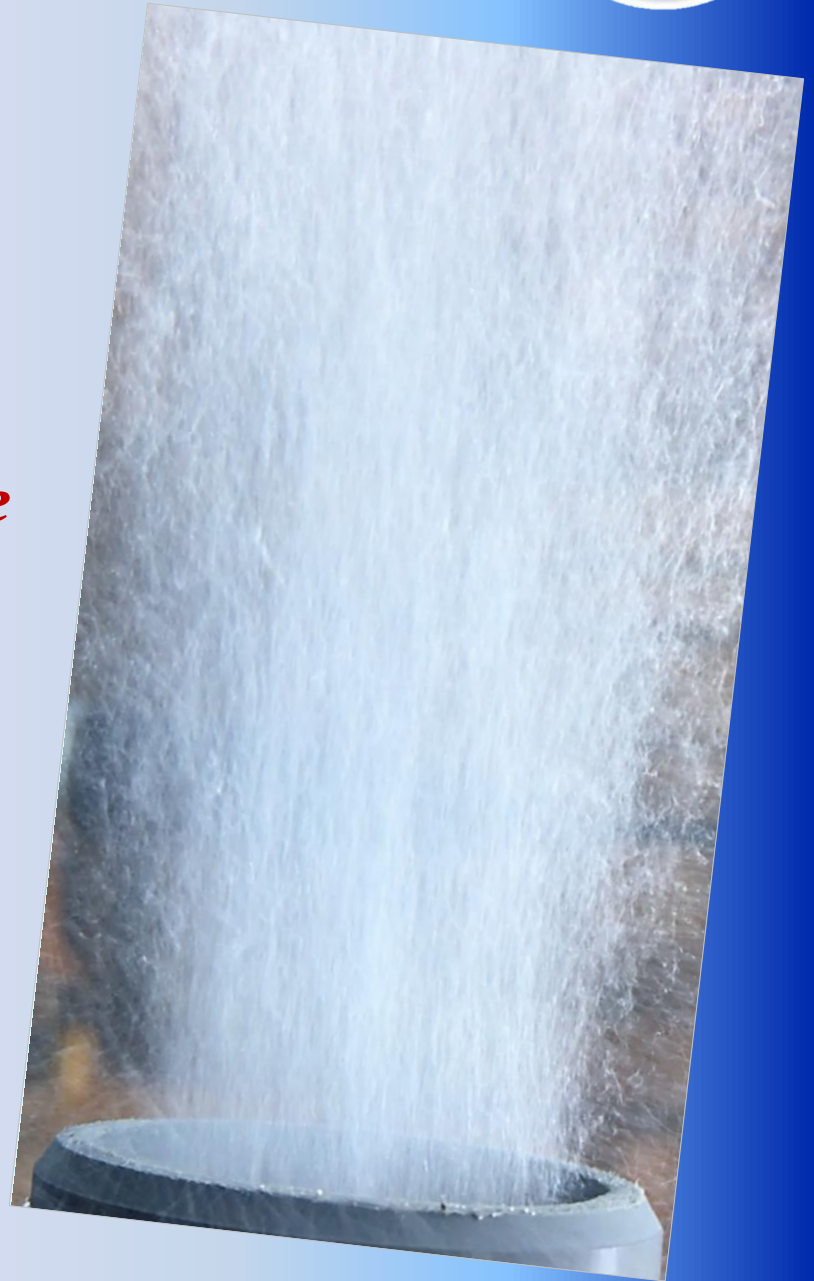


# ***A.R.S -Heap Leaching Technology***



***ARS Nanobubble  
Generator  
Mining Solutions  
Products  
For Copper ,Nickel  
and Gold Heap  
Leaching Process,  
ILS ,PLS & Raffinate  
Pond .***



***ARS Nanobubble Generator is the most  
efficient aeration technology to transfer  
oxygen into the leaching Solution .***

# Nanobubble Generator

The ARS Nanobubble Generator is the most efficient aeration technology to transfer virtually any gas into any solution liquid. The generator produces trillions of nanobubbles, ~100nm in size, providing more than 200-times the interfacial surface area of conventional ultra-fine micro bubbles.

The ARS Generator transfers gas with greater than 90% efficiency, providing maximum utilization potential, improving the functionality of heap leaching solution, and enhancing the recovery processes. ARS Generator nanobubbles remain in suspension after saturation, creating a reserve of available oxygen/gas in the irrigation system-solution for heap leaching method.

## Features & Benefits

- 💧 > 90% standard oxygen transfer efficiency ("SOTE")
- 💧 ~ 100nm in size.
- 💧 Smallest size bubbles creating 200 x the interfacial surface area compared to micro bubbles.
- 💧 Highest concentration of bubbles per cm<sup>3</sup> ( >100M bubbles/cm<sup>3</sup> )
- 💧 Nanobubbles stay suspended in the solution after solution reaches saturation during the percolation.
- 💧 Increases solutions capacity to hold a given gas.
- 💧 Low-turbulent gas diffusion.
- 💧 Reduces the density of water, therefore reducing friction.





# Nanobubble Technology Is Revolutionizing Heap Leaching

The ARS Nanobubbles significantly increase the surface area available for chemical reactions, accelerating the leaching process and improving extraction efficiency. By optimizing oxygen levels and enhancing mass transfer, Nanobubble technology offers numerous advantages in heap leaching operations.

## How

When the Zeta potential of Nano bubbles and ore particles are opposite in charge, electrostatic attraction occurs. This interaction increases the likelihood of Nano bubbles attaching to the surface of the ore. As a result, the contact time between the leaching solution and the ore is extended, improving the efficiency of metal dissolution.

Enhanced Oxidation:  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$ , Accelerating redox reactions, particularly  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  regeneration.

During the leaching process,  $\text{Fe}^{3+}$  ions act as strong oxidizing agents, especially for refractory ores like chalcopyrite. As  $\text{Fe}^{3+}$  oxidizes the metal, it is reduced to  $\text{Fe}^{2+}$ , which needs to be reoxidized back to  $\text{Fe}^{3+}$  to sustain the leaching cycle.

Nano bubbles play a key role in this redox regeneration by:

- Providing a high surface area for oxygen transfer.
- Enhancing oxygen dissolution in the leach solution

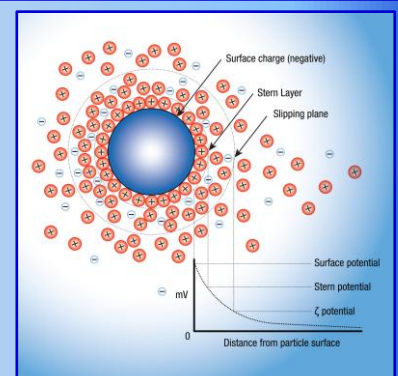
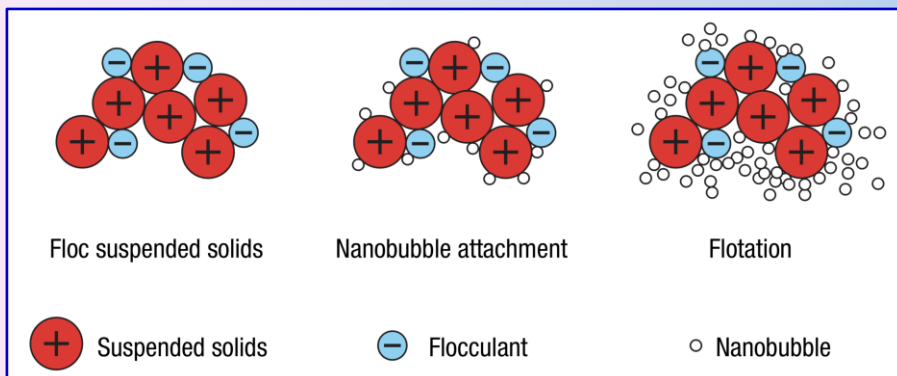
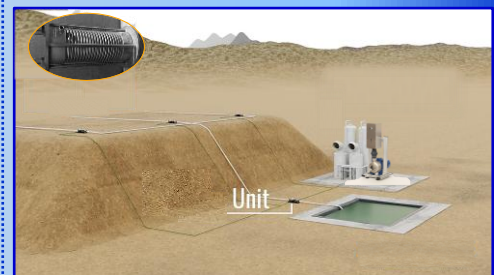
Accelerating redox reactions, particularly  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  regeneration

- Possibly generating reactive oxygen species (ROS) that accelerate  $\text{Fe}^{2+}$  oxidation.

The presence of nano bubbles therefore promotes faster and more efficient oxidation of  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$ , maintaining high oxidizing potential in the system.

## Applications

- 💧 Sulfide & Chalcopyrite Heap Leaching -PLS/ILS & Raffinate.
- 💧 Bioheap bacterial leaching technology.
- 💧 Gold heap leaching.
- 💧 Flotation.





# High Quality Nanobubble Generator

## Features

- 💧 No Moving Parts
- 💧 Plug-and-Play
- 💧 Self-Cleaning.



**ARS** - Aqua Royal Spring  
Heap Leaching Technology

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