HERON INNOVATORS
The Clear Advantage

Suspended Air® Flotation
A New Environmental Remediation Tool

Developed by Heron Innovators, Inc.

Suspended Air® Flotation (SAF®) is the latest innovation in environmental remediation that utilizes a stable gas/liquid emulsion of micro-bubbles of air (or other gases can be used) dispersed in water. This emulsion (froth) contains 40–65% air by volume in the form of micron sized bubbles having a size range of 7 to 25 microns. The individual bubbles exhibit a milky appearance like that of thin shaving cream. These bubbles have several unique attributes that make them superior for flotation, for example: smaller size bubbles (7 to 25 microns), double film wall for bubble stability and chemical reactivity, none to minimal bubble coalescence (Figure 1), greater reactive surface area per unit volume, variable charged bubbles (anionic/cationic) and surface tension advantage for both bubble generation and dewatered float solids. SAF® bubbles use low concentrations of surfactant, (less than 50 parts per million).

The number of working bubbles contained within 10 gallons of Suspended Air® froth is astronomical. Based on an average size of 7-25 microns, there are over 1,000,000,000,000,000 (1 quadrillion) bubbles that are entrained by Heron Innovator's SAF® generator. For example, 10 gpm SAF® froth is necessary for attachment to clarify approximately 200-500 gpm of untreated water.

For the first time in the environmental wastewater treatment field, the ultimate tool using SAF® makes it possible to treat all types of municipal, industrial, agricultural and natural contaminated water and wastewater. SAF® is a simple, low cost, most effective technology that can be used to supplement/or as alternative to the many conventional treatment techniques (ion exchange, ultrafiltration, adsorption, clarification, air stripping, etc.).

Traditional Dissolved Air Flotation (DAF) uses gas (usually air) dissolution generating micro-bubbles optimistically ranging in size from 20 to 30 microns (realistically these bubbles are 50 microns plus). While DAF does not employ chemicals to generate bubbles, it is energy intensive. Further, the bubble generation (saturation) can be affected by the nature of the liquid characteristics and conditions (i.e., dissolved solids, temperature, etc.) used to dissolve the gas into solution. With DAF, condition of design can have an adverse effect on the bubbles like coalescence. Figure 1 (below) illustrates the coalescing versus non-coalescing bubbles.

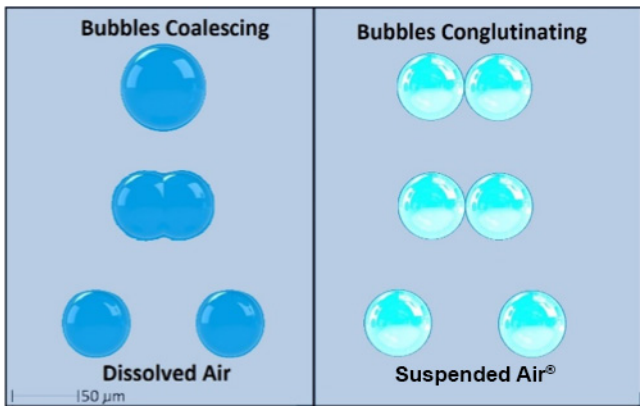

Figure 1. Coalescing versus non-coalescing. Coalescing bubbles take on more air and grow larger. Non-coalescing bubbles retain their size from their original formation.

What is Flotation and Flotation Engineering's Present Status?

Particulate flotation is a process wherein air bubbles in a liquid attach themselves to small particles suspended and rise to the surface where they are concentrated and removed. The concentrate particle (solids) can easily be removed, discarded or recovered (if of value).
Three types of particulate flotation are Induced Air Flotation (IAF), Dissolved Air Flotation (DAF) and, the innovative, Suspended Air® flotation (SAF®).

Induced air flotation (IAF) has been used in the mining industry since 1916. This process concentrates, selectively separates and quantitatively recovers metallic and industrial minerals. The mining industry has developed the science of selective, high efficiency IAF which is characterized using hundreds of special flotation chemicals. This type of flotation has very limited application to the treatment of industrial wastewaters because of the great differences in specific gravities of the solids. The bubble sizes are large (500-1000 microns) and strong, energy intensive agitation is needed in the flotation cell for simultaneous heavy particle suspension and bubble generation. These are poor conditions for the flotation of flocculated, low specific gravity particles (organics). These types of solids require quiescent conditions for efficient flotation. Also, IAF is inefficient in the flotation of many very fine mineral particles and fine coal.

Dissolved Air Flotation (DAF) is the extension of the flotation process to the treatment of flocculated solids of low specific gravity (such as food wastes, paper pulp, oil, sewage) where much finer bubbles (less than 100 microns) and quiescent flotation cell conditions are needed. The finer bubbles are produced by supersaturating (dissolving) a recycle water stream with air at pressures of 60 to 120 psig. When the pressurized recycle stream is mixed with the wastewater to be treated (within the flotation cell at atmospheric pressure) the dissolved air is released in the form of tiny bubbles, many forming directly on suspended particles. No chemicals are used for bubble formation or to achieve any type of bubble selectivity. The mount of air available for flotation is limited by its saturation efficiency in water. Therefore, to provide the amount of air necessary, substantial recycle streams (100 to 300 percent of the influent flow rate) are needed. DAF has been used in many industries for treating wastewater since the 1950s.

Suspended Air® flotation (SAF®) has been developed to create the ideal range of operating conditions to insure the optimum flotation for varying types of suspended solids and the additional ability to float soluble impurities in water such as heavy metals, hydrocarbons, dyes, etc.

Heron Innovators' innovative flotation technology advantages:

- Generate continuously and quantitatively a stable flotation medium.
- Produced total physical and chemical control of micro-bubble .
- Transport of stable SAF® froth at the most advantageous injection location(s) under complete flow control.
- Customized flotation cell design for efficient flotation, removal and dewatered float solids.

Figures 2 and 3 illustrate the bubble size comparison and air in water by volume of SAF and DAF unit process, respectively.

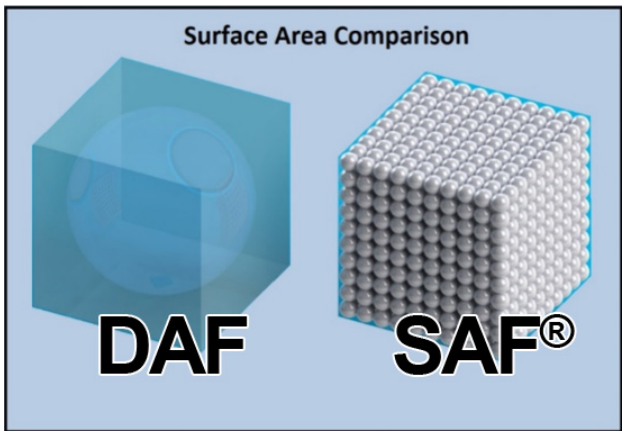

Figure 2. Surface Area with respect to volume. The surface area decreases as bubbles begin coalescing. With non-coalescing bubbles, there is a much larger surface area when considering a unit of volume.

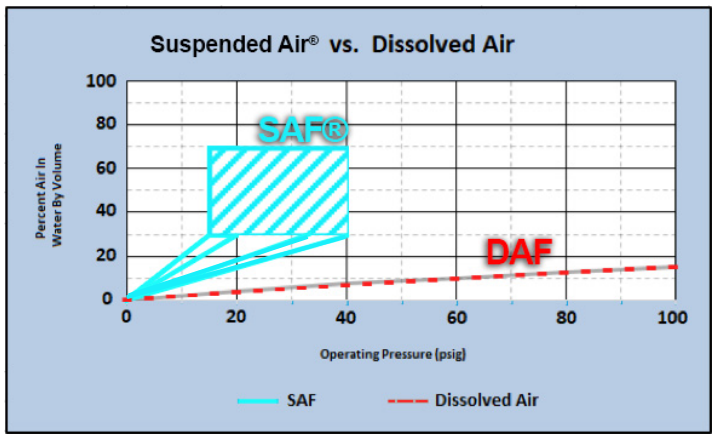

Figure 3. Pressure comparison between Heron Innovators technology versus conventional methods.

What's New?

Suspended Air® flotation is the only flotation process that provides total control over both the bubble generating process and flotation cell conditions. This superior level of control makes it possible to offer the most effective flotation unit process available for the purification of varying wastewater applications.

www.heroninnovators.com | info@heroninnovators.com | (916) 408-6601
1025 Nichols Drive, Rocklin, CA 95765

The applications today for this most advanced technology:

1. Upgrading/retrofitting existing DAF installations to improve the flotation efficiency, greatly increase capacities, minimization of chemical consumption and significantly reduce power demand.
2. Substitution of a low cost SAF® technology for other types of expensive and/or space intensive wastewater liquid-solids separation equipment (i.e., clarifiers, granular media filters, gravity belt filters, centrifuges, settling tanks, ponds/lagoons, etc.).
3. The expansion of flotation technology into both current and new areas of water treatment where present limitations of traditional flotation have prevented its practical application.

This innovative flotation technology has a 20-year track record treating varying types of wastewater like algae removal, suspended solids for Title 22 compliance, water reclamation, mixed liquor, proteins (beef and poultry), dairy and cheese, other consumable fats, oils and greases. Figure 4 (below) illustrates the compact skid mounted Suspended Air® flotation process and ancillary equipment.

Figure 4. Suspended Air® Flotation Process – Entire Skid Mounted Water Treatment System; Inclusive of SAF Generator, Clear Floater, Serpentine Style Mixing Chamber, Chemical Staging, Polymer Mixer/Aging System, Flocmixer, Flowmeters, Solids Hopper, Pumps, PLC Cabinet and Maintenance Platform. (8’ x 16’ skid can accommodate up to 1,000 gpm)

www.heroninnovators.com | info@heroninnovators.com | (916) 408-6601
1025 Nichols Drive, Rocklin, CA 95765

Benefits of Suspended Air® Flotation Technology Are:

- Simplicity of operation
- Lowest capital & operating costs
- Lowest energy demand
- Smallest footprint
- No hazardous operating conditions
- No hazardous by-products
- Highest product recovery
- Highest water reclamation
- Highest contaminant removal

Heron Innovators, Inc., offers a completely integrated packaged water treatment systems ranging from 25 to 9,000 gpm on a continuous or semi-continuous operation.

Table 1. Comparison of SAF® with DAF Thickening of Waste Activated Sludge (WAS)

Parameters	DAF	SAF®	Comments
WAS Flow Rate (MGD)	1.5	1.5	
WAS Suspended Solids (mg/L)	4,000	4,000	
Recycle Percent (%)	72	2.4	*Suspended Air® is not pressurized -90% power savings*
Flow Rate to Flotation Cell (GPM)	1,792	1,067	*Suspended Air® Flotation Capacity 3 times DAF*
Hydraulic Flow Rate including Recycle GPM/ ft^2	1.3	10.2	*Hydraulic loading rate 8+ times DAF*
Flotation Surface Area	1,378	105	*Significantly Less Flotation Area Required*
Solids Surface Loading Rate Lbs/hr/ft^2	1.5	20	
Solids in Float; Percent (%)	2.25	6	
Solids in Underflow (mg/L)	200	25	*Solids capture with Suspended Air® Flotation is consistently better than 99.5%. Effluent may be discharged with plant secondary effluent.*

www.heroninnovators.com | info@heroninnovators.com | (916) 408-6601
1025 Nichols Drive, Rocklin, CA 95765