

DIFLOAT™

DISSOLVED
AIR
FLOTATION
SYSTEM



*“DIFLOAT™” Dissolved Air Flotation (DAF) system.
Highly efficient and compact Clarifiers and Thickeners for
municipal and industrial water and wastewater treatment.*

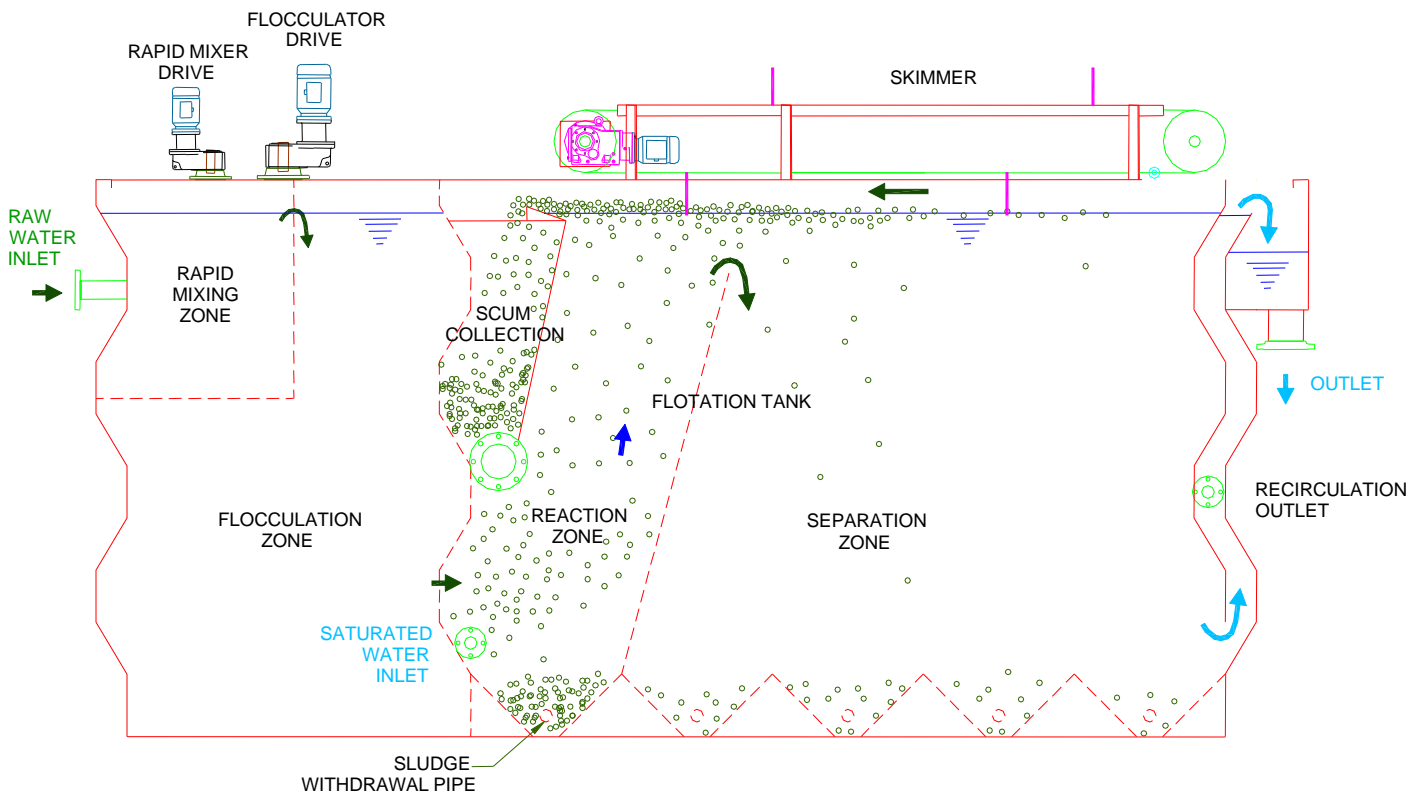
 **NAPIER-REID** Since 1950
Water & Wastewater Treatment

DIFLOAT™ Dissolved Air Flotation System

Dissolved Air Flotation (DAF) is a process used for the separation of suspended solids and dispersed liquid from a liquid by addition of saturated air-water mixture which releases micro bubbles. The micro air bubbles adhere to or enmesh in the suspended composite particles, which then rise to the surface due to their reduced density. Skimming operation removes the particles floated to the surface.



Napier Reid's "DIFLOAT™" DAF systems remove total suspended solids (TSS); algae; fats, oils and greases (FOG); and associated biological oxygen demand (BOD) and chemical oxygen demand (COD) from a variety of water and wastewater. DIFLOAT™ DAF systems are used as a clarifier and also as a sludge thickener.

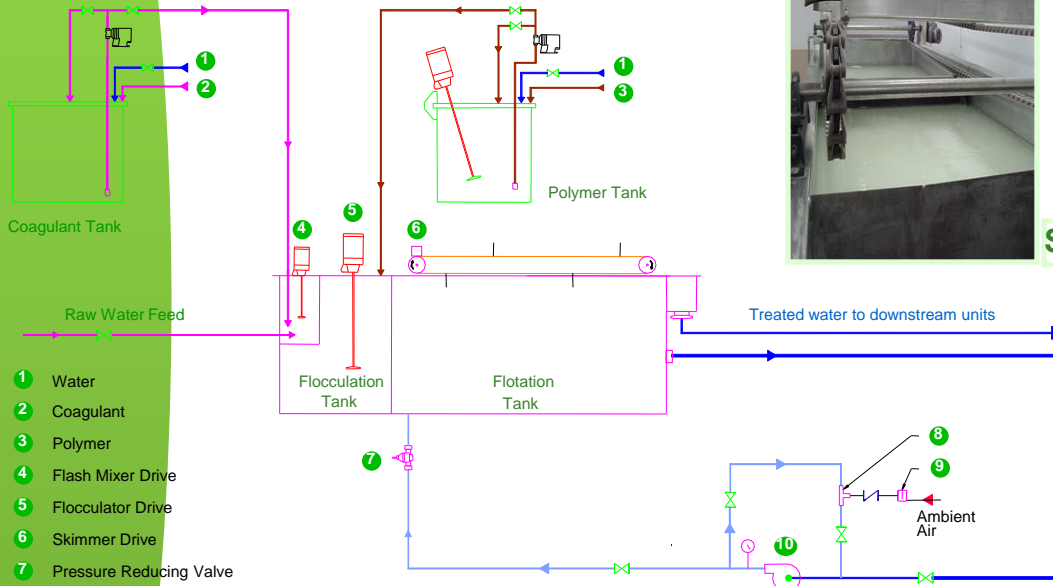


Schematic diagram of DAF Tank

Dissolved Air Flotation Process

DAF is a physical process that operates on a simple design philosophy which combined with optimum conditioning chemistry and properly designed equipment provides an efficient mechanism for solids and FOG separation.

The micro air bubbles adhere or enmesh to the suspended composite particles, which then raise to the surface due to their reduced density. At the surface, a mechanical float removal device (skimmer)



Skimmer

Process Flow Diagram

Incoming raw water is pre-treated with a coagulant and flocculant in the rapid mixing and flocculation chamber. The use of chemicals such as alum, ferric chloride and de-oiling polymers enhances the flotation process by forming composite particles or flocs. The chemically treated raw water enters the flotation chamber where it's mixed with the injected supersaturated water (also known as whitewater). The DAF pump recycles a percentage of the finally treated water and produces supersaturated water by mixing water and air at high pressure. A pressure-reducing valve reduces the pressure of recycled supersaturated flow to atmospheric pressure just before it enters the flotation tank. The sudden decrease in pressure releases micro bubbles of size 10 to 50 microns.

consisting of a full width scrapper with rubber blades travels over the tank surface and pushes the float over the beach plate into the scum collection channel. Heavier sludge settles in the bottom of the tank and a sludge draw-off pipe intermittently removes it. Selecting the correct frequency of scum removal mechanism and travel speed of the scrapper is important to get the desired solids content in the scum.

The clarified water reaches the end of the flotation tank which then flows under a baffle and into a collection trough, or is collected by submerged perforated pipe laterals.

The clarified water then flows by gravity for further processing.

Important Design Parameters of DIFLOAT™ DAF System

Coagulation & Flocculation

Coagulation is the process of destabilizing colloidal particles so that particle growth can occur because of particle collisions. Coagulant is a chemical added to destabilize the colloidal particles and help floc formation.

Flocculation is the process that brings about the collisions between the destabilized suspended and colloidal particles to form larger particles that can be removed readily.

Coagulation and flocculation are the mechanisms by which the suspended particles and colloidal materials are removed from the water during the flotation process. Optimization of coagulation and flocculation is necessary for optimum performance of flotation system. The type and amount of chemical dosing, intensity of mixing, detention time in the rapid mixing zone and flocculation zone and floc size are the key parameters that play an important role in the performance of the flotation system.

Air to Solid (A/S) Ratio

Air to solid ratio is the principal design parameter for a dissolved air flotation system. It is a theoretical measure of the quantity of air available per quantity of solid to be removed. Typical values range between 0.005 – 0.06 ml/mg.

For the air dissolving saturator vessel, the relation between A/S ratio, solubility of air, operating pressure, solid concentration, flow rate and recycle rate is given by the following equation:

$$A/S = \frac{1.3 * Sa * (f P - 1) * R}{Ss * Q}$$

Factors influencing dissolved air flotation plant efficiency:

- Coagulation and Flocculation
- Concentration of raw water
- Air to Solid Ratio
- Particle Rise Velocity
- Hydraulic Loading Rate
- Solid Loading Rate
- Recycle Ratio

- A/S= air to solid ratio, mL(air)/mg(solids)
- 1.3 = weight constant of air, mg/mL
- Sa = solubility of air in water, mL/L
- f = fraction of saturation, usually 0.5
- P = recycle system pressure, atm
- Ss = influent suspended solids, mg/L
- R = pressurized recycle flow rate, m³/day
- Q = raw water flow rate, m³/day

Recycle Ratio

The recycle ratio is the fraction of the final effluent produced which is returned and supersaturated with air under pressure before entering the flotation tank where the sudden pressure reduction causes the release of air in the form of micro bubbles. The recycle ratio ranges from 8% to 150% based on the quality of raw water to be treated.

Air dissolution rate is proportional to absolute pressure as per Henry's Law of partial pressure of gases adjacent to liquids. Hence, the higher the operating pressure of DAF pump or air/water saturation vessel, higher the air solubility and thus lower the required percentage recycle.

DIFLOAT™ DAF system comes with DAF pump that operate at 100 psi achieving above 92% air solubility. The DAF pumps are capable of mixing 36 to 200 SCFH air. The air eductor loop draws in ambient air and supplies it to DAF pump. Hence compressed air supply is not required.

If Napier-Reid's saturator vessel skid is selected instead of DAF pump to produce supersaturated water, it operates at 50 to 60 psig pressure and an air dissolving efficiency of over 80%. By any of the above two methods, micro bubbles in the range of 10 to 50 microns are formed which reduces the recycle ratio.



Saturator Vessel Skid under manufacturing

Hydraulic Loading Rate (HLR)

The hydraulic loading rate is a measurement of the volume of influent applied per unit of effective surface area per unit of time. This results in process design figures expressed as equivalent up-flow velocities with units of m/hr. HLR is depended on various factors, however it ranges from 4 to 12 m/hr. The maximum HLR must be less than the minimum rise velocity of the solids-air particle to ensure that all of the particles will float to the water surface before the water reaches the discharge end of the tank. The hydraulic loading rate is checked based on influent flow rate and also total flow rate (influent + recycle flow).

Industry	Hydraulic Loading Rates
Petroleum/Petrochemicals/Power plants	6 to 8 m/hr
Meat processing/Rendering	5 to 7 m/hr
Poultry/Dairy plants	4 to 6 m/hr
Pulp and paper industry	5 to 6 m/hr
Municipal water treatment	6 to 12 m/hr

Typical Hydraulic Loading Rates in DIFLOAT™ DAF system

Solids Loading Rate (SLR)

Solids loading rate is the ratio of the total amount of solid and FOG in influent to the effective surface area in the flotation tank. Unit is mass per unit of area per unit of time (kg/m².hr).

The average design SLR ranges from 4 kg/m².hr up to 18 kg/m².hr with chemical addition. In general, increasing the SLR will decrease the float concentration.

Advantages of DIFLOAT™ DAF System

- ▶ Small, compact and robust unit occupies a smaller footprint utilizing the space more efficiently.
- ▶ The process and equipment is specifically designed for each application for optimum operation achieving a TSS removal efficiency of over 95%.
- ▶ The rapid mixing and flocculation chamber is an integral part of the DAF system.
- ▶ Optimum use of coagulants and flocculants leads to a decreased consumption, hence a low operating cost.
- ▶ The removal of solid sludge settled at the tank bottom is independent of the skimmer flights removing scum at top. Thus the flotation tank is free of turbulence keeping a clearer effluent.
- ▶ Design allows for a reasonable change in water depth and skimmer flight submergence to accommodate a change in float weight and displacement.
- ▶ Flexible, designed to handle a reasonable variation in influent water quality and flow rate to some extent.
- ▶ Robust and efficient DAF recycle pump provides high air dissolving efficiency with less horsepower. The air eductor loop draws in ambient air and supplies it to the recycle stream. Hence a compressed air supply is not required.
- ▶ Amount of pressurized recycle flow, and amount of air mixed is easy to control, leading to higher flexibility.
- ▶ Standard material of construction is stainless steel. However, tank in other materials can provided, if required.
- ▶ Easy to install and operate.
- ▶ Easy to service and clean.
- ▶ High quality drive and pumps for long maintenance free operation.
- ▶ Existing systems are operating smoothly and at very high efficiency
- ▶ Full support of experienced process designers and field personnel during all stage of the project – from preliminary designing up to commissioning and operation.

Besides all of the above, DIFLOAT™ DAF system has the technical and field support of Napier-Reid, a leading innovative supplier of engineered solutions and equipment for over 50 years. The combined cumulative experience of Napier Reid's process designers in water and wastewater treatment is over 300 years.

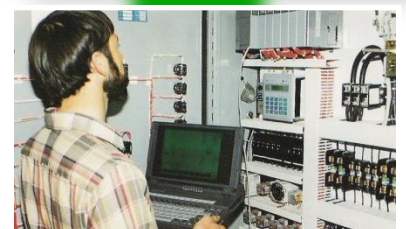
Equipment & Process



Operation & Maintenance



Support & Services

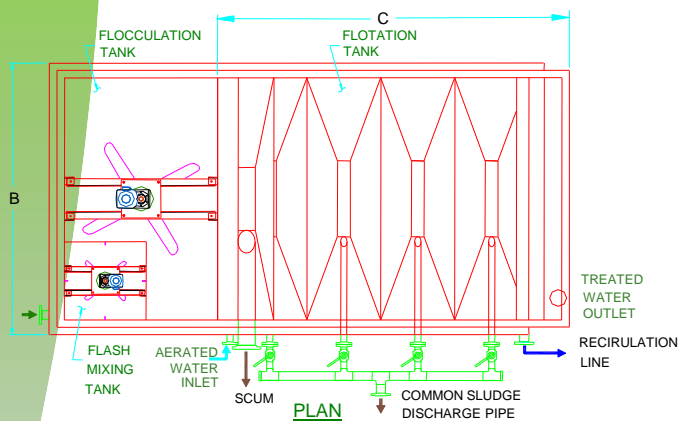


DIFLOAT™ DAF Plants Dimension ******

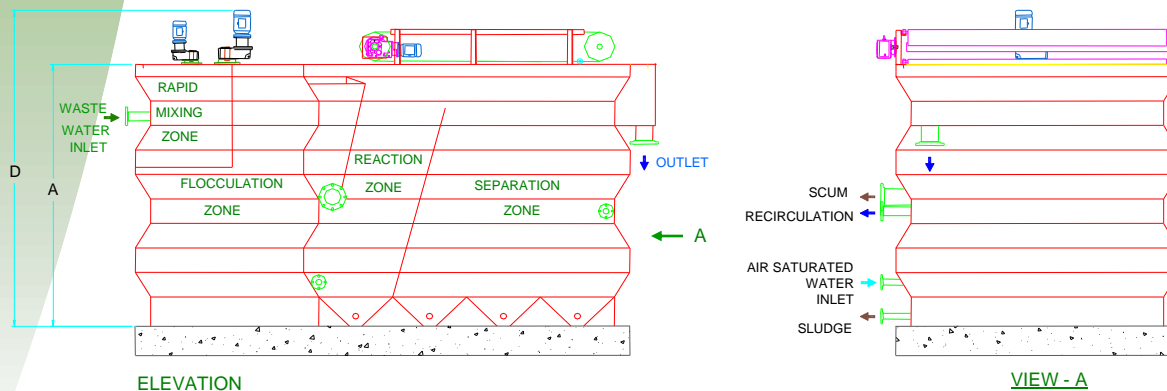
Model	Flow Rate ¹ (m ³ /hr)	Effective Surface Area (m ²)	Tank Depth A (mm)	Effective Width B (mm)	Effective Length C (mm)	Total Height D (mm)
DAF020	12	2.0	2000	1000	2000	2800
DAF030	18	3.0	2000	1000	3000	2800
DAF050	30	5.0	2000	1000	5000	2800
DAF070	42	7.0	2500	2000	3500	3000
DAF100	60	10.0	2500	2000	5000	3000
DAF125	75	12.5	2500	2000	6250	3000
DAF150	90	15.0	2500	2000	7500	3000
DAF200	120	20.0	2500	2500	8000	3200
DAF250	150	25.0	2500	2500	10000	3200
DAF300	180	30.0	2500	3000	10000	3200
DAF350	210	35.0	2500	2500	14000	3200
DAF400	240	40.0	2500	2500	16000	3200

** Due to continuous R&D and our best efforts to improve our systems, the dimensions are subject to change without prior notice.

- 1) Flow rate is based upon a typical rise rate of 6 m/hr. Rise rates range from 4 to 8 m/hr depending upon the type of wastewater.
- 2) Recirculation flow rate will vary according to the type of wastewater, concentration of suspended solids level in the wastewater and effluent quality required at the outlet of DAF.



DAF Pump



DIFLOAT™ DAF Tank General Arrangement

DIFLOAT™ DAF Applications

Municipal

- Water treatment plant
- Wastewater treatment plant
- Biological treatment plant
- Algae removal

Industrial

- Poultry plants
- Meat processing industries
- Fish processing industries
- Rendering plants
- Dairy plants
- Food processing industries
- Petroleum/Oil refinery
- Petrochemical plants
- Pulp and paper industries
- Mining



Influent to
DIFLOAT™ DAF System



Effluent from
DIFLOAT™ DAF System



About Napier - Reid

Over 60 years of excellence in water & wastewater treatment

Napier-Reid is located in the greater Toronto area in the Province of Ontario, Canada. We supply engineering services and process equipment for water and wastewater treatment.

We have the technology, resources and experience to design, manufacture and implement innovative water and wastewater treatment solutions worldwide. We have completed over 3000 projects since our inception in 1950. This stands as a testament of our ongoing commitment of providing the highest quality service, products and after sales support in the industry. Our capabilities include engineering, manufacturing, installation and field support. We have in-house personnel for complete mechanical, electrical and instrumentation process and control system design. As a manufacturer, our designs focus on cost-effective solutions, simplicity of installation and ease of maintenance.

Napier-Reid has developed an excellent team with many years of experience. We have a well-deserved reputation for innovation, service and integrity. A significant portion of Napier-Reid's revenue comes from export to regions such as the Caribbean, Central America, South America, Middle East, Eastern Europe, Africa, and Asia. Some of these projects are financed by Canadian government or International financing institutes. As a Canadian manufacturer, we are eligible for Canadian governmental funding and EDC export credit. We have the capability to handle a large range of projects, from engineering, equipment supply, installation, start-up, to turnkey projects. Let Napier-Reid be your solution for water and wastewater purification.



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