

The
Induced Cyclonic Separator/MASS
(IC-SEP*)MASS

Separating Waste from Water

ACQUA International Group [“ACQUA”] - Muddy River Technologies

ACQUA/Muddy River are involved in the extraction of waste from water using proprietary technologies sold under the following brand names:

- *Vertical Gravity Separator (VGS*)*
- *Induced Cyclonic Separator (IC-SEP*)* MASS
- *Cyclonic Falling Film Evaporator (CycloVap*)*
- *Inline Swirl Generator Hydrocyclone Head (ISG*)*
 - *Liquid/Liquid*
 - *Solid/Liquid*
- *Liquid Skimmer (Skimmer*)*

The ACQUA/Muddy River technologies are involved in the following market segments and applications:

- *Oil-water separation*
- *Fat, oil and grease recovery/removal*
- *Marine bilge water treatment and marina oil slicks clean-up*
- *Soil remediation*
- *Tertiary sewage treatment*
- *Recovery of backwash water*
- *Removal of suspended solids*
- *Treatment of wastewater from food and chemical manufacturing, pulp and fines recovery.*

* Indicates International Patents Pending

CONTENTS

1	THE INDUCED CYCLONIC SEPARATOR (IC-SEP*)	1
1.1	Applications	1
1.2	Features and Benefits	2
1.3	How does it Work?	3
2	DIAGRAMS	4
2.1	Deoiling IC-SEP*MASS	4
2.2	Solids Removal IC-SEP*MASS	5
3	TECHNICAL PAPER	6
	“A Novel Approach to Wastewater Treatment”	7-15
	<i>David McKenzie (September 9th, 1999)</i>	
4	PROJECT SUMMARIES	16
4.1	SPC Limited	17-18
4.2	Delta Juice Co Ltd	19-20
4.3	Port of Brisbane Corporation	21-22
4.4	IT Environmental	23-24
5	LIST OF IC-SEP*MASS PROJECTS	5 2
6	INDUSTRY INTEGRATION FLOWCHART	27

1 THE INDUCED CYCLONIC SEPARATOR (IC-SEP*)MASS

The Induced Cyclonic Separator (IC-SEP*) is a highly innovative, patented solid-liquid and liquid-liquid separation system. Developed and manufactured in Australia, the IC-SEP* is set to revolutionise the way flotation systems have been received.

Advances in providing high aeration levels and intimate contact between bubbles and the dispersed phase, have led to a novel separation system that significantly reduces costs, provides unrivalled separation efficiencies, dramatically less chemicals and less space and can perform separation operations previously impossible to achieve.

There are a number of key functional principles dissolved air floatation systems must adhere to:

- **High surface area micro bubbles must be formed to maximise effluent separation.**

The IC-SEP* bubble size and surface area can be controlled by varying the backpressure and the airflow rate. That the micro bubbles are stable and re-active towards the dispersed phase is of key significance.

- **Increasing the concentration of bubbles maximises the lift performance.**

The IC-SEP* unit processes all the wastewater flow and air through a pressurised cyclone. The air dissolves and all process flows are intimately mixed in the highly aerated water.

- **The smaller micro bubbles adhere better to the fragile flocculated particles.**

The IC-SEP* produces micro bubbles that form multiple contacts and because all the process flow is being aerated, superior lift is achieved. The capacity to provide sustained vertical lift leads to high sludge concentrations and a smaller footprint.

- **The method of pressure control throughout the circuit is paramount for quality bubble production.**

The IC-SEP* is novel in that the dispersion of micro bubbles in the float cell is vastly improved due to the method of dissolution down the cyclone chamber.

1.1 Applications

- Separation of flocculated matter in clarification of surface water and wastewater.
- Thickening of sludge from wastewater treatment and drinking water clarification.
- Separation of metal hydroxides or pigments in treatment of industrial wastewater.
- Separation of emulsified oils and greases from refineries, steelworks, metal fabrication and similar industries.
- Separation and recovery of fibres in pulp and paper mills.
- Recovering catalyst from refined hydrocarbons.
- Cleaning oil contaminated solids.
- Breaking of oil, paint and latex emulsions.
- Separation of industrial waste.

1.2 Features and Benefits

- Superior separation of contaminants. Up to 95% reduction in Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and suspended solids.
- Air aspiration straight from the atmosphere. No air blower or compressor required.
- Small footprint reduces capital costs.
- Only 2 moving parts creates minimal maintenance.
- Process efficiency improvement. Capture and re-use more valuable resource material, whilst water is also cleaner than similar systems.
- Modular design and ease of scale up.
- Reduced chemical consumption.
- More compact sludges.

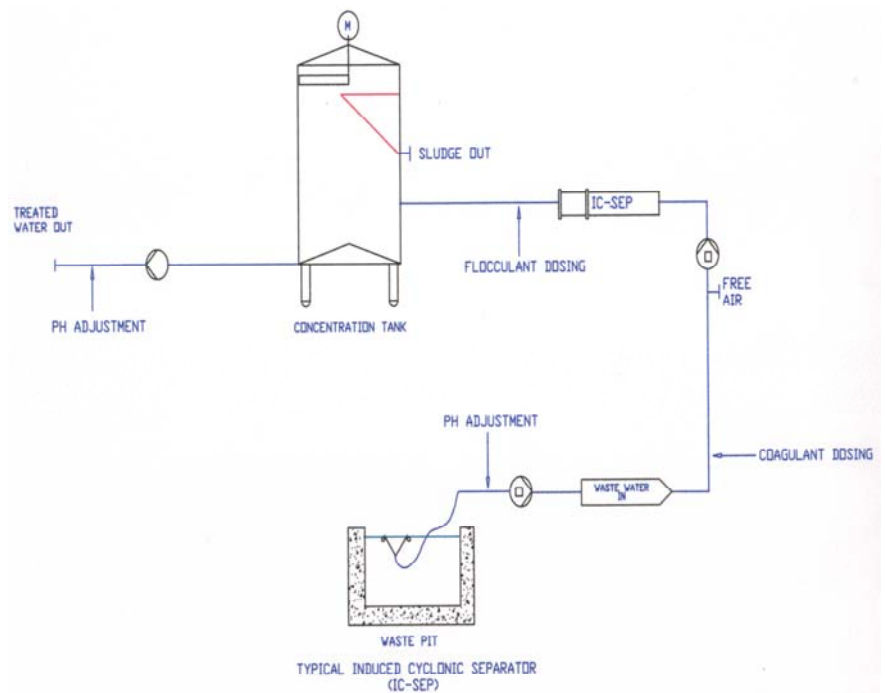
1.3 How does the IC-SEP* work?

The system exploits the density difference between two phases primarily by attaching air bubbles to one phase and floating it away for collection. This idea is not new, but the method by which it is achieved using the IC-SEP* is set to revolutionise how we think about dissolved air flotation (DAF).

The IC-SEP* works by dissolving air into the total effluent flow, which is up to 5 times more air than traditional DAF systems. The air is dissolved by entraining free air into the suction of a positive displacement pump and then inducing a cyclone inside the patented IC-SEP* unit. The pressures and forces created ensure intimate mixing of the air and the fluids to be separated causing the air to be fully dissolved rather than entrained. The pressures that are used are up to two times that used in traditional DAF systems thereby further increasing the amount of air able to strip out any suspended solids.

But more importantly, there are no moving parts in the IC-SEP* unit itself. The fluid spins itself through specially designed channels. And because this is achieved without moving parts, maintenance costs are reduced significantly.

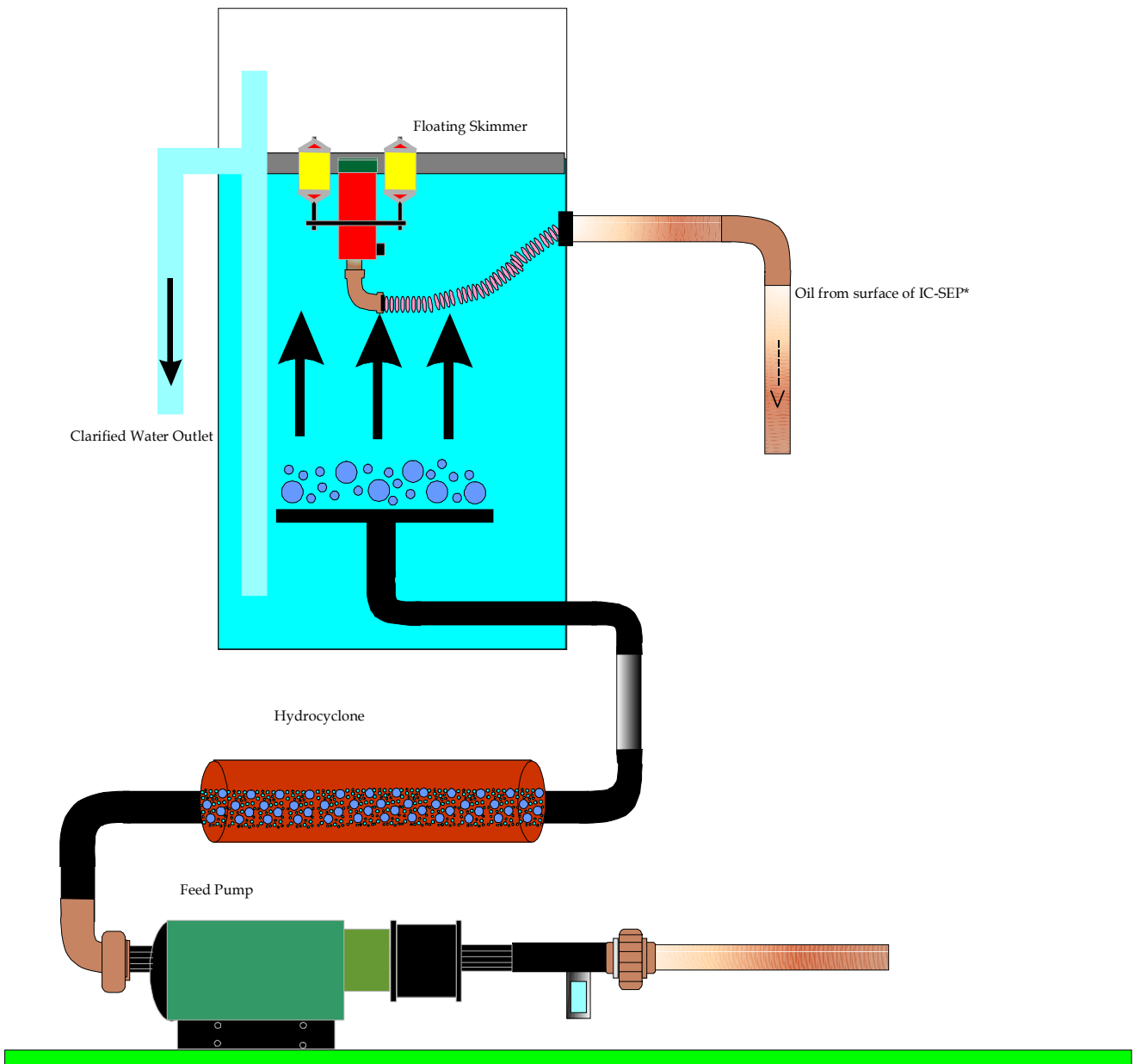
In addition to the air flotation system, it is often necessary to adjust the electro-potential of the wastewater. It is also possible to use chemicals such as coagulants and flocculants to help create surfaces or structures that can easily attach to the air bubbles. Coagulants are used to bind the particulate matter together, and flocculants are used to



change the surface tension on the liquid/solid and or liquid/gas interfaces. The combination of all three regimes will almost always bring about separation. However, using the IC-SEP* technology, it is usually sufficient to utilise one or two, and still accomplish a satisfactory result.

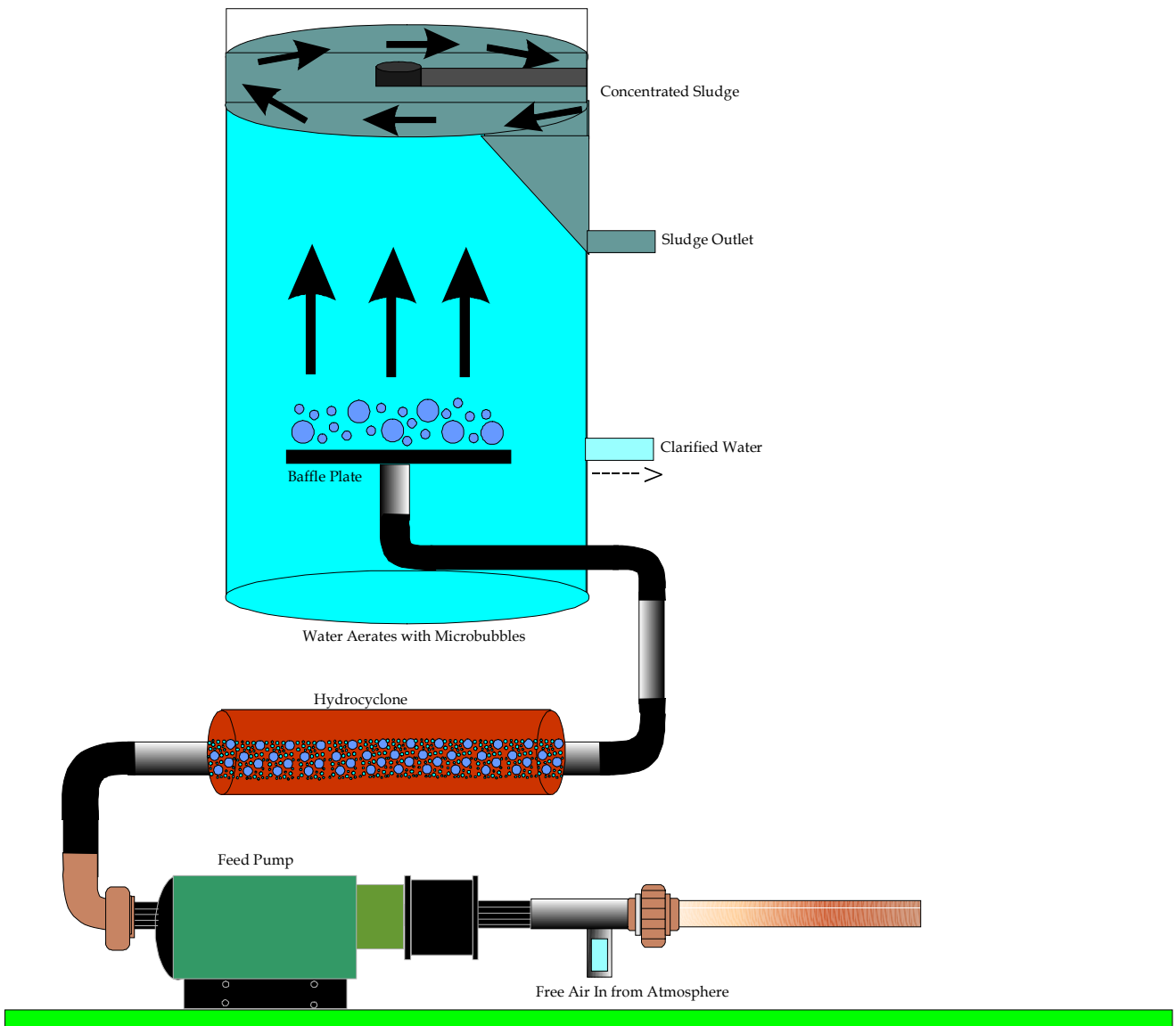
2 DIAGRAMS

2.1 Deoiling IC-SEP*MASS System



2.2

Solids Removal IC-SEP*MASS System



“A NOVEL APPROACH TO WASTEWATER TREATMENT:
THE INDUCED CYCLONIC SEPARATOR (IC-SEP*)”

David McKenzie
B Eng (Chem)(Hons)
University of Melbourne

Winner of the
Hepburn Prize

September 9th, 1999

“A Novel Approach to Wastewater Treatment: Induced Cyclonic Separation (IC-SEP*)”

Abstract

Qualitative and quantitative trials were conducted on a newly developed wastewater treatment system. The system, called the Induced Cyclonic Separator (IC-SEP*) works by air flotation, and as such was compared to traditional Dissolved Air Flotation (DAF) systems. These initial trials show that the IC-SEP* can remove solids and other contaminants from waste and product streams much more efficiently than DAF systems. For a wide range of phase separation operations, the IC-SEP* has displayed significant cost savings, which is of substantial interest to all industries.

Keywords

Wastewater, Dissolved air flotation, Phase separation, Chemical Unit Process, IC-SEP*

1.0 Introduction

A commonly used method of wastewater treatment is the Chemical Unit Process. This is the process whereby a chemical reaction (or reactions) brings about the treatment of wastewater, which precipitates the dissolved solids. An important subset of the Chemical Unit process is the flotation operation. It is this operation that is of interest to this paper.

For waste treatment, Chemical Unit Processes alone are widely accepted to be far more effective than Physical Unit Processes. However, a common criticism of the Chemical Unit Process is that it is an additive process. Dissolved solids in the form of precipitation chemicals must be added to bring about an overall reduction of dissolved matter. In comparison to a Physical Unit Process, running costs of a Chemical Unit Process can be significant because of the chemicals used and additional energy required to effect phase separation.

Therefore in order to take advantage of the effectiveness of the Chemical Unit Process, it is of great interest to industry to find ways to reduce the chemical and energy costs of the procedure.

It was the application of these cost reduction criteria to traditional DAF (Dissolved Air Flotation) technology that brought about the development of the IC-SEP* (Induced Cyclonic Separator). The purpose therefore of this paper is to ascertain the relative benefits of using the IC-SEP* over other Chemical Unit Processes for the secondary treatment of industrial wastewaters.

1.1 Previous Research Activity

As the IC-SEP* is a newly patented (pending) design, limited previous research into the operational parameters of the system has been undertaken. Therefore it is intended that this paper form the basis for further study, whilst still examining the system in enough detail order to gain an understanding of the possible future applications for the design.

1.2 IC-SEP* Operation

The IC-SEP* is a novel separating system that can be used in a wide variety of applications. Many separation operations that have previously been too costly, or in some cases impossible to achieve are easily and inexpensively undertaken using this system.

The system exploits the density difference between two phases primarily by attaching air bubbles to one phase and floating it away for collection. Often this operation requires the use of chemicals to bring about precipitation of solids that can then subsequently attach to the air bubble. This idea is not new, but the way it is achieved using the IC-SEP* is quite revolutionary.

The IC-SEP* works by entraining free air into the suction side of a positive displacement pump and then inducing a cyclone inside the specially designed IC-SEP* unit. The pressures and shear forces generated in the uniquely shaped fluid channels ensure intimate mixing of the liquid/solid phase with the partially dissolved entrained air.

1.3 Testing Parameters and Procedures

For the purposes of this paper, the IC-SEP* was trialed on the following waste streams shown in Table 1. In addition to the IC-SEP*'s performance for wastewater treatment using chemicals, as a control experiment, the IC-SEP* was assessed for its efficacy in removing fruit fibre from fruit juice, without the use of chemicals.

Table 1., Industries and Effluent types chosen for IC-SEP testing*

INDUSTRY	EFFLUENT #	EFFLUENT TYPE
Margarine Processing	1	Factory Effluent
Meat Processing / Abattoir	2	Factory Effluent
Cheese Processing	3	Factory Effluent
Dairy Processing	4	Cream Washdown Effluent
Dairy Processing	5	Milk Washdown Effluent
Dairy Processing	6	Ice cream Washdown Effluent
Dairy Processing	7	Ageing area Washdown Effluent
Dairy Processing	8	Factory Effluent

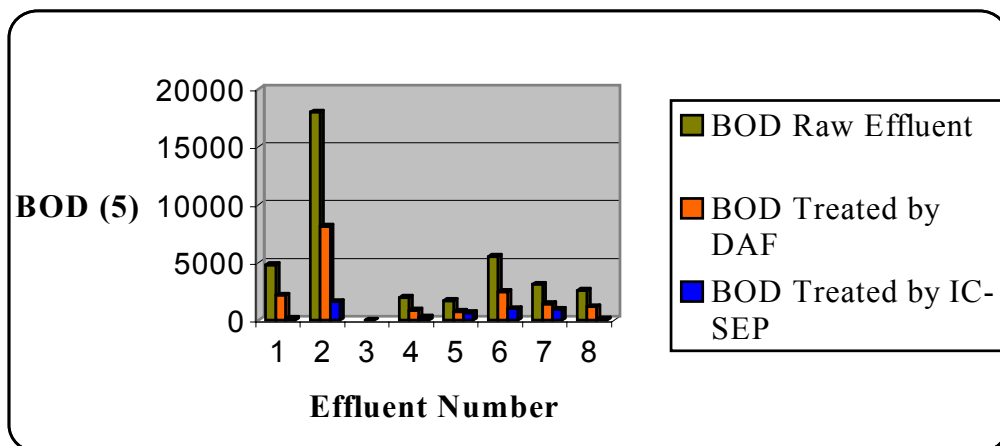
For the purposes of data collection, the following methodology was used. A sample of the raw effluent was taken as a control sample. Next a sample was taken of the wastewater after treatment with the IC-SEP* system. These samples were tested for appropriate effluent quality parameters for each industry.

2.0 Discussion

2.1 Biological Oxygen Demand (BOD₅) Reduction

Biological Oxygen Demand (BOD₅) reduction was measured for the effluent numbers 1, 2, 4, 5, 6, 7, 8. (See Table 1., for details). The results are shown graphically in *Figure 1*. The figures demonstrate the marked BOD₅ reduction possible using the IC-SEP*. This is primarily due to the coagulation of suspended and dissolved solids using cationic coagulants. Simple DAF systems will also show a BOD₅ reduction but not to the same efficiency. The average BOD₅ reduction for DAF) systems is shown in Figure 1., based on an assumed BOD₅ reduction of 40-70% (average 55%) (Metcalf & Eddy, 1991)

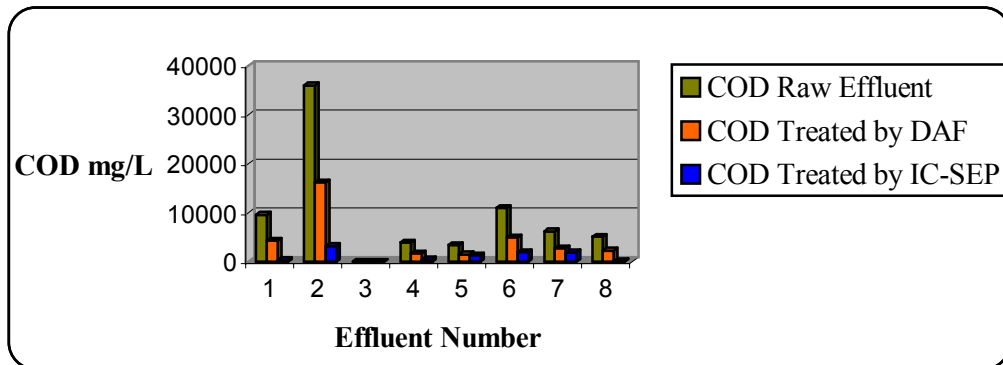
Figure 1, BOD₅ Reduction using IC-SEP test unit*



2.2 Chemical Oxygen Demand (COD) Reduction

Chemical Oxygen Demand (COD) reduction was measured for the effluent numbers 1, 2, 4, 5, 6, 7, 8. (See Table 1., for details). The results are shown graphically in *Figure 2*. The figures demonstrate the marked BOD reduction possible using the IC-SEP*. The average COD reduction for DAF systems is shown in *Figure 2.*, based on an assumed COD reduction of 30-60% (average 55%) (Metcalf & Eddy, 1991)

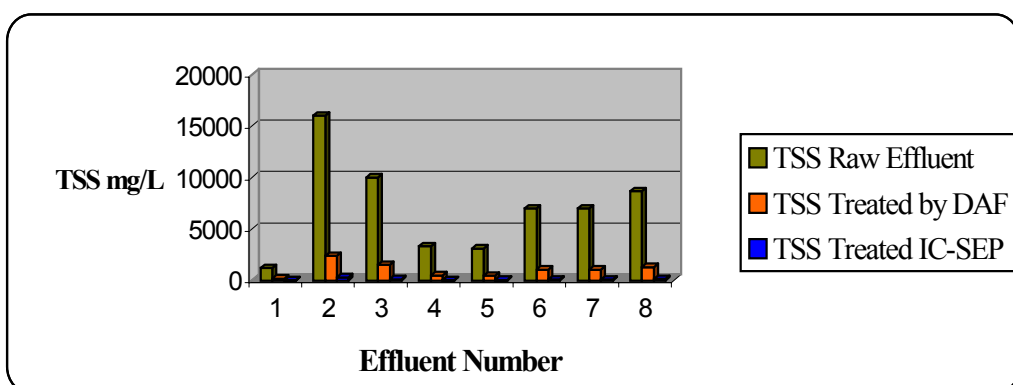
Figure 2., COD Reduction using IC-SEP test unit*



2.3 Total Suspended Solids (TSS) Reduction

Total Suspended Solids (TSS) reduction was measured for the effluent numbers 1, 2, 3, 4, 5, 6, 7, 8. (See Table 1., for details). The results are shown graphically in *Figure 3*. The average TSS reduction for DAF systems is shown in *Figure 3.*, based on an assumed TSS reduction of 80-90% (average 85%) (Metcalf & Eddy, 1991)

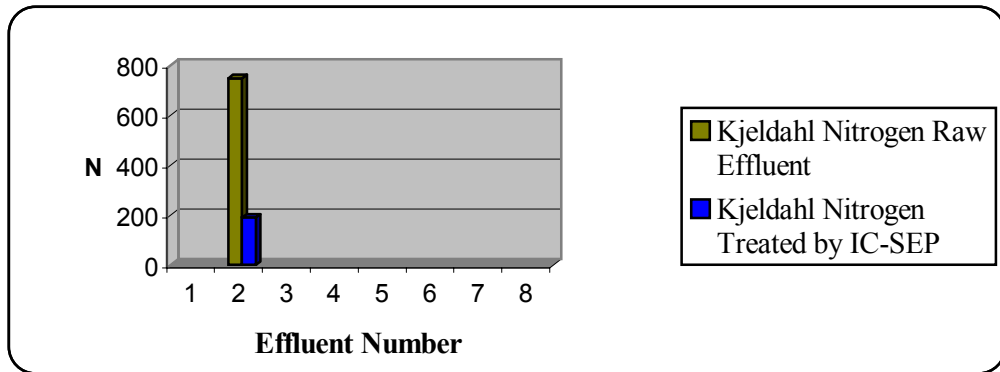
Figure 3., TSS Reduction using IC-SEP test unit*



2.4 Nitrogen Reduction

Nitrogen (Kjeldahl) was measured using effluent number 2 (See Table 1., for details). The results are shown graphically in *Figure 4*.

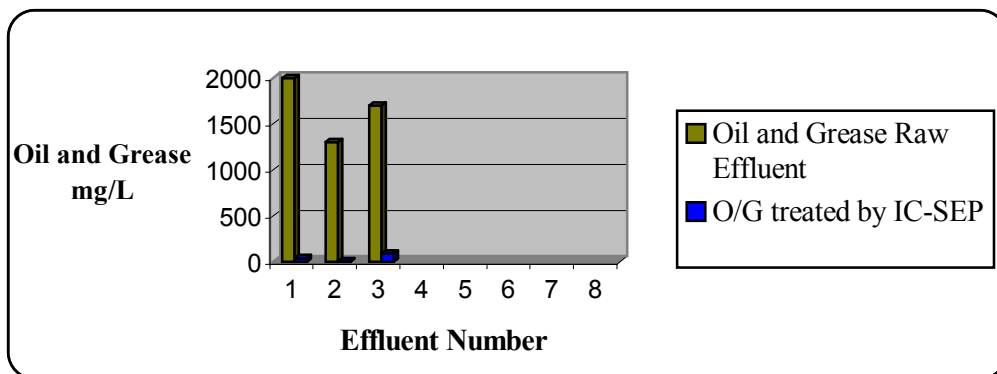
Figure 4., Nitrogen Reduction using IC-SEP test unit*



2.5 Oil and Grease Reduction

Oil and grease levels were measured using effluent numbers 1, 2, 3, (See Table 1., for details). The results are shown graphically in *Figure 5*.

Figure 5., Oil and Grease Reduction using IC-SEP test unit*



2.6 Chemical Usage and Energy Consumption

Our investigation has highlighted scope for cost reduction over traditional DAF systems. Operational costs will be markedly reduced using the IC-SEP* system in at least four key areas.

Due to the high turbulence and shear created in the IC-SEP*, the air particles are semi-dissolved to a size approaching 1-micron. This has two benefits to the separation operation. Firstly, the air bubbles are of an equivalent size to the smallest solid particles, and are able to be attached more easily. Secondly, the high shear also brings the air bubbles and solid particles into much closer proximity, so the adsorption is more likely. The combined result of these two effects augments the separation operation to such an extent, that in most cases, chemical usage is reduced dramatically. Cost savings can be very significant.

The operation is achieved without the use of compressed air. The suction to the positive displacement pump is kept in a continual negative pressure regime. As this is the place where the air is admitted into the system, the entrainment of air is performed with little or no additional energy consumption, and no additional high maintenance equipment. The air is dissolved into solution by the high shear and turbulence created by the IC-SEP*. Capital investment and operational costs associated with pressurisation equipment common to traditional air flotation systems are not incurred.

The enhanced water clarity is the result of improved BOD, TSS, and Oil and Grease reduction. This reduces the loading on the effluent stream, thus leading to reduced trade waste charges.

As the *only* moving part in the entire IC-SEP* system is the rotor of the positive displacement pump, the maintenance cost for the unit is minimal. Standard servicing of this pump and the chemical dosing pumps is all that is required.

2.7 Fibre stripping from pear juice

In order to compare the effectiveness of the IC-SEP* without the use of chemicals, the unit was tested with pear juice containing 2% fibre. The IC-SEP* was used to strip fibre from the juice prior to processing in an Ultra-filtration system in order to increase the processing time between filter backwashing. The IC-SEP* was able to remove 98.5% of the fibre in a single pass operation. This increased cycle times on the filtration system by 800%. From these figures it was shown that the air dissolution in the liquid phase using the IC-SEP* was ideal for phase separation operations. This perhaps explains the ability of the system to outperform normal DAF systems when treating wastewater with precipitation chemicals.

3.0 Conclusions

In comparison to traditional DAF systems, trailing with the IC-SEP* clearly shows several significant economic and operational benefits.

The critical wastewater parameters of the IC-SEP* treated effluent all show marked improvement over both the untreated and DAF treated effluent.

For BOD₅ and COD reduction, the IC-SEP* outperformed the DAF by reducing loading by an average of 83.7% as opposed to a reduction of 55% using traditional DAF) systems. (Metcalf & Eddy, 1991)

For TSS, the IC-SEP* showed an average reduction of 98.2% as opposed to a typical reduction of 85% by a DAF system. (Metcalf & Eddy, 1991)

Whilst the maintenance and energy costs were not quantitatively examined during this study, it was very apparent from the discussion in section 2.6 above that the IC-SEP* system would have much lower operating costs than equivalent traditional technology. These values would form the basis for valuable future studies.

4.0 Acknowledgements

The following companies have assisted in the preparation of the data for the trials:

- SPC Pty Ltd
- Bonlac Foods Pty Ltd
- Export Meat Packers Pty Ltd
- Meadow Lea Foods Pty Ltd
- Blue Dairy (Philippines)
- Process System Technologies Pty Ltd

5.0 References

1. Metcalf & Eddy: Wastewater Engineering, 3rd ed., McGraw-Hill, New York, 1991, pp303

Pilot IC-SEP*MASS Test Results

1 Margarine/Spreads

Company	Meadow Lea Foods	
Location	Port Melbourne, Victoria, Australia	
	Initial (mg/l)	Treated (mg/l)
BOD	4800	160
TSS	1200	44
Oil & Grease	2000	40
Turbidity (NTU)	1100	28

2 Meat Processing/Abattoir Effluent

Company	Export Meat Packers	
Location	Victoria, Australia	
	Initial (mg/l)	Treated (mg/l)
BOD	18000	1600
TSS	16000	300
Oil & Grease	1300	7
Kjeldahl Nitrogen	750	190

3 Processed Cheese

Company	Bonlac	
Location	South Melbourne, Victoria, Australia	
	Initial (mg/l)	Treated (mg/l)
TSS	10000	120
Oil & Grease	1700	92
Total Protein (TKN)	6140	800

The above information is confidential & should not be disclosed to third party without written approval of ACQUA International (Australia) Pty Ltd

4 Dairy Effluent

Company	Peters & Brownes	
Location	Western Australia, Australia	
	Initial COD/TSS (mg/l)	Treated COD/TSS(mg/l)
Dairy Waste - Cream	3900/3300	470/30
Dairy Waste - Milk/ Water	3400/3100	1300/60
Dairy Waste - Ice Cream	11000/7000	2000/100
Dairy Waste - Ageing Tank/Rework	6200/7000	1900/90

5 Snack Foods

Company	Smiths Snack Foods	
Location	Perth, Western Australia, Australia	
	Initial (mg/l)	Treated (mg/l)
BOD	>6600	210
TSS	6300	270
COD	11000	170

6 Ready Meals

Company	Kailis & France	
Location	Perth, Western Australia, Australia	
	Initial (mg/l)	Treated (mg/l)
BOD	>1500	210
TSS	7800	170
Oil & Grease	300	13

The above Information is confidential & should not be disclosed to third party without written approval of ACQUA International (Australia) Pty Ltd

4 PROJECT SUMMARIES

SPC Limited

Delta Juice Co Ltd

Port of Brisbane Corporation

IT Environmental

4.1

SPC Limited

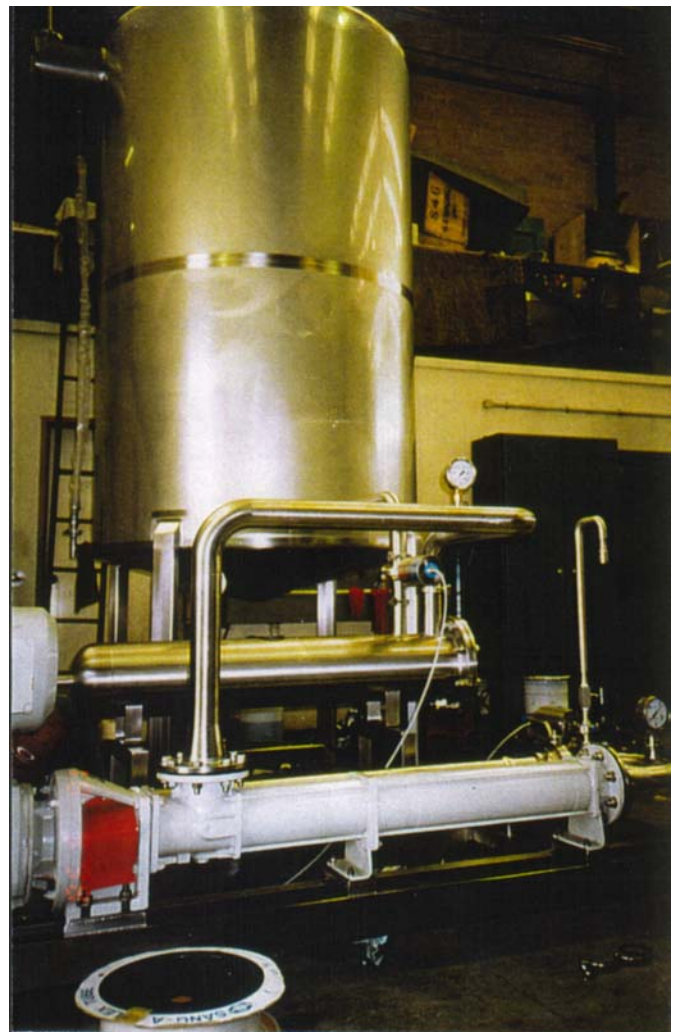
Client	SPC Limited
Location	Shepparton, Victoria, Australia
Product	Induced Cyclonic Separator (IC-SEP*)MASS

Objective

To achieve longer run times on an Ultra Filtration (UF) plant processing apple and pear juices, reduce Cleaning In Place (CIP) cycles and times and improve percentage yield (recovery) of fruit juices.

Background

Fibre and solids removal from food process streams has traditionally required the use of expensive centrifuges, decanters or filters. All these systems require high capital expenditure, maintenance and operating costs.



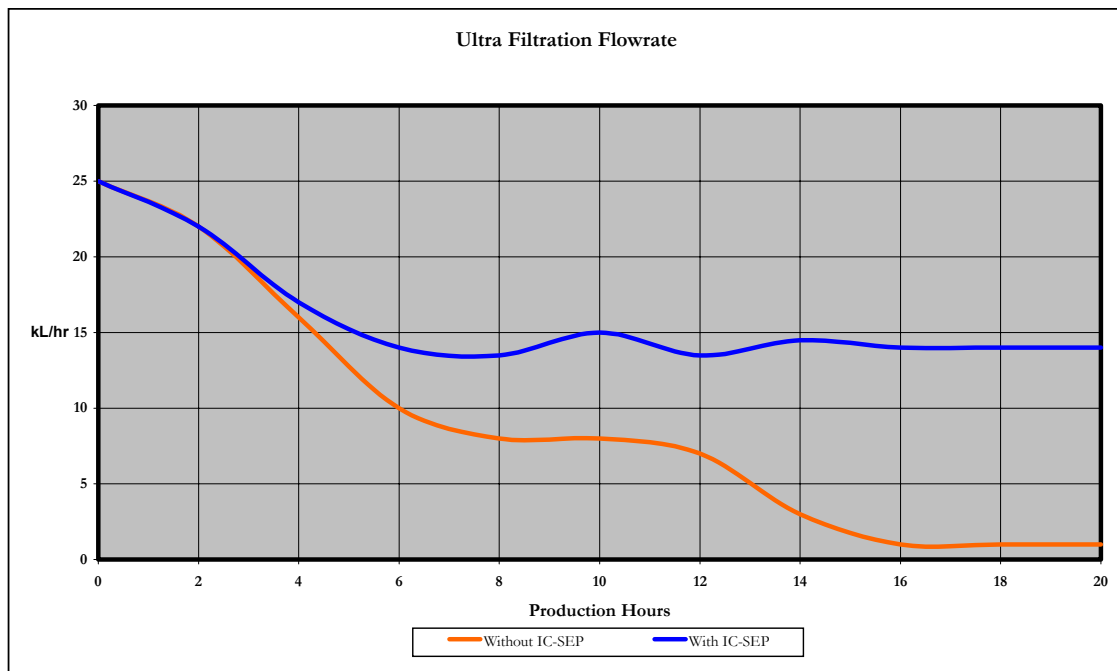
Solution

In order to offer the food industry a cost effective alternative to these expensive processes, ACQUA International (Australia) Pty Ltd has modified the revolutionary Induced Cyclonic Separator (IC-SEP*) system to create a totally hygienic fibre removal system.

The IC-SEP* system has dramatically improved the UF plant run times between CIP cleaning and considerably improved the percentage yield of fruit juices. Added benefits have been a reduction in maintenance costs and substantial reduction in the membrane replacement costs for the UF plant.

Prior to the installation of the IC-SEP* system, the UF plant continually fed fibre back into the feed tank as the clarified fruit juice was removed prior to evaporation. This caused the UF feed tank to fill with fibre, which required it to be dumped after running for less than 24 hours. The loss of juice and the loss of time for CIP was the driving force for installing the IC-SEP*.

The IC-SEP* draws fibre rich juice from the UF feed tank. It removes the fibre and returns the juice to the feed tank, thus ensuring continuous operation of the UF plant. With the IC-SEP*, operators are able to choose when to perform CIP, rather than have the necessity of CIP be dominated by physical constraints.



4.2 Delta Juice Co Ltd

Client	Delta Juice Co Ltd
Location	Long An, Vietnam
Product	Induced Cyclonic Separator (IC-SEP*)MASS

Objective

To meet the discharge specification for industrial wastewater as required by the Vietnamese Government Authorities.



Background

Delta Juice is a greenfield tropical fruit processing facility producing single strength juice (SSJ) and fruit juice concentrates.

As there is no access available to a municipal sewer system, the factory amenities waste is mixed with the fruit processing effluent and treated before discharging to a nearby river.

Solution

An Induced Cyclonic Separator (IC-SEP*) system, complete with a rotary screen, pH adjustment and coagulant and flocculent dosing, controlled by a Programmable Logic Controller (PLC).

The plant has received a compliance certificate from the relevant Vietnamese Government Authorities confirming that the wastewater, after treatment in the IC-SEP* plant, meets with the most stringent discharge requirements

Performance data of the Delta Juice IC-SEP* is shown below:

	Raw Effluent (mg/L)	Treated Effluent (mg/L)	Percentage Reduction
Biological Oxygen Demand (BOD)	2000	20	99
Chemical Oxygen Demand (COD)	2000	50	97.5
Total Suspended Solids (TSS)	>2000	50	97.5

4.3 Port of Brisbane Corporation

Client	Port of Brisbane Corporation
Location	Brisbane, Queensland, Australia
Product	Vertical Gravity Separator (VGS*) and Induced Cyclonic Separator (IC-SEP*)MASS

Objective

To remove oily contaminants from bilge water and diesel refuelling spills so that the impact to the environment at the Port Of Brisbane, Queensland Australia Operations Base (Whyte Island) is kept to a minimum.



Background

The Port of Brisbane Corporation decided to embark upon a system of environmental controls to limit the impact they have on the surrounding marine environment. During an environmental audit, it was found that the discharge of bilge water and the possibility of refuelling spills constituted a major risk. The Port Corporation decided that the best way to treat their problem was to install a Vertical Gravity Separator (VGS*) and an Induced Cyclonic Separator (IC-SEP*) to treat all the bilge water from their vessels. The system was designed to allow for the additional treatment of accidental spills from Port Corporation refuelling operations.

Solution

The challenge was to design a system that would allow potentially contaminated waters to be treated and discharged directly to the marine environment. The VGS* is now generally accepted as the most efficient way to separate free oil from oil/water system. So the VGS* was chosen as the primary treatment device.

The VGS* alone is not able to completely eliminate the oil from partially emulsified oil/water mixture. The IC-SEP* was chosen as the means by which the remaining oils could be removed. The IC-SEP* continually aerates the effluent liquor to remove any remaining oils in the system.

The oils are constantly removed, concentrated and collected for easy disposal. Because of the low level of oil remaining in the cleaned water, it can be discharged directly to storm water without endangering the environment.

4.4 IT Environmental

Client	IT Environmental
Location	Carlton, Victoria, Australia
Product	Vertical Gravity Separator (VGS*) and Induced Cyclonic Separator (IC-SEP*)MASS

Objective

To purify groundwater contaminated by petroleum hydrocarbons in order to allow for a residential redevelopment.



Background

The site in Carlton, Melbourne Australia was previously a service station that had been decommissioned and removed. During operation and decommissioning of the service station large amounts of petroleum products leaked in to the surrounding soil. During soil-sampling and groundwater investigations the degree of contamination was high enough that development of the site was unable to proceed without complete site decontamination.

Solution

The IT Group were responsible for delivering groundwater to the treatment system, and ACQUA were responsible for undertaking the processing of the groundwater to remove hydrocarbons and to ensure the discharge of clean water from the site to sewer. ACQUA designed a system that utilises an Induced Cyclonic Separator (IC-SEP*), a Vertical Gravity Separator (VGS*) and a series of carbon filters. The complete system is capable of treating 3,000 litres per hour.

The contaminated groundwater is pumped to a preliminary holding tank capable of storing 3,600 litres of effluent. A floating skimmer removes free and floating hydrocarbons to the VGS*. Within the VGS*, a pure hydrocarbon phase is separated from the water and directed into a vessel for containment and disposal. Water containing the remaining dissolved phase hydrocarbons is pumped to the patented IC-SEP* system.

This oil/water mixture is mixed with a dissolved air stream from the IC-SEP* unit. Separation of the oil phase from the water phase occurs in the flotation tank where the dissolved air comes out of solution and rises slowly to the surface collecting the hydrocarbons and bringing them to the surface for removal. A floating skimmer removes these floating hydrocarbons with some of the water from the top of the flotation tank and this stream is also pumped to the VGS*.

Treated water from the IC-SEP* system is finally passed through two carbon adsorption columns where any remaining hydrocarbons are removed. This is the final polishing step before the clean water is stored in a final holding tank for testing prior to eventual discharge to sewer. A vapour removal system is installed to each of the tanks and pulls out any volatiles given off in the process and these volatiles are removed in a carbon adsorption canister.

Parameter (µg/L)	Groundwater Inlet	Post VGS	Post IC-SEP	Post Carbon Filter
Benzene	0.54	0.44	0.053	<0.001
Ethylbenzene	0.053	0.074	0.004	<0.001
Toluene	3.1	1.6	<0.010	<0.001
Xylene	31	3.6	0.003	<0.001
TPH c6-c9	280	15	2.7	<0.05
TPH c10-c14	240	23	6.3	0.48
TPH c15-c28	240	25	5.0	0.1
TPH c29-c36	2.4	0.3	0.1	<0.1

5 LIST OF IC-SEP*MASS PROJECTS

Detailed below is a complete list of IC-SEP* systems that have been installed by ACQUA.

Client	Country	Industry	Throughput (L/hr)	Application
Greenwich Pizza	Phillipines	Catering	1,500	Wastewater
Blue Dairy	Phillipines	Dairy	1,500	Wastewater
Shanghai Piggery	China	Feed Lot	6,000	Wastewater
Fiesta Brands	Phillipines	Food Production	85,000	Wastewater
Saizeriya	Australia	Food Production	36,000	Wastewater
Smiths Snackfoods	Australia	Food Production	30,000	Wastewater
Delta Juice	Vietnam	Fruit Juice	16,000	Wastewater
Siam Foods	Thailand	Fruit Juice	15,000	Fruit Pulp Removal
SPC	Australia	Fruit Juice	13,000	Fruit Pulp Removal
Nuttlelex	Australia	Margarine Production	3,000	Wastewater
Port of Brisbane	Australia	Marine	3,000	Bilge Water Treatment
GEO2	Australia	Potable Water	3,000	Water Treatment
GEO2	USA	Sewage	30,000	Sewage Sludge Thickening
Meriton Apartments	Australia	Soil Remediation	20,000	Ground Water Remediation
Caltex	Australia	Soil Remediation	3,000	Ground Water Remediation
Shell	Australia	Soil Remediation	3,000	Ground Water Remediation
Mobil	Australia	Soil Remediation	3,000	Ground Water Remediation

6 INDUSTRY INTEGRATION FLOWCHART

This industry integration flowchart illustrates the applications for the IC-SEP* and other ACQUA proprietary technologies.

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