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- SEPARATION
- MEMBRANE
- DISINFECTION
- BIOSOLIDS
- REUSE

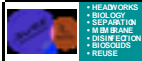
## Degremont

### Water Clarification Technologies

#### Case Study of AQUADAF Clarifier

presented by

**Mukesh GROVER**  
Technical Director



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- DISINFECTION
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## Degremont

over 70 years of providing treatment solutions


### Wide range of treatment solutions

- Headworks
- Biology
- **Separation**
- Membrane
- Disinfection
- Biosolids
- Recycle/Reuse

#### Degremont Water Clarification Technologies

- **Turbocirculator** - solids contact
- **Densadeg** - high rate solids contact with lamellatube
- **Pulsator** - pulsating sludge blanket
- **Pulsatube** - pulsating sludge blanket with lamella tubes
- **AquaDAF** - very high rate dissolved air flotation

Water India 2011 (Delhi)  
Slide 2



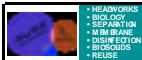
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## Degremont Clarification Technologies

### Typical Clarification Rates and Application

Clarification Technology	Typical Clarification Rates (m/hr)	Typical Application	Major Indian Installations
<b>Turbocirculator<sup>®</sup></b>	2.0 to 3.5 (upto 5.0 for softening)	Clarification, Softening	Delhi, Angul (Orissa)
<b>Densadeg<sup>®</sup></b>	10.0 to 20.0 (upto 30 for softening) (upto 100 for storm water)	Clarification, Softening, Storm water clarification, Filter Washwater clarification	Delhi, Bangalore
<b>Pulsator<sup>®</sup></b> <b>Pulsatube<sup>®</sup></b>	2.5 to 4.0 4.0 to 8.0	Clarification (>10 NTU)	Delhi, Chennai, Bangalore, Mumbai, Kolkata
<b>AquaDAF<sup>®</sup></b>	25.0 to 40.0	Clarification (<50 NTU)	Bangalore

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Slide 3



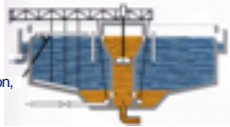

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## Turbocirculator™ Clarifier

### High rate solids contact type reactor clarifier

#### Typical applications:

- DW : Clarification, Lime Softening, Presetter
- WW : Primary & Tertiary Clarification
- IWW/PW : Carbonate removal, Metal Precipitation, Colour removal

#### Features:

- Simple & robust process
- Very efficient
- Multiple application

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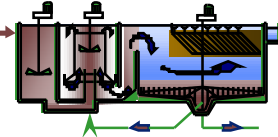
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## Densadeg™ Clarifier

*High rate solids contact type Lamella clarifier*


**Typical applications:**

- DW : Clarification, Lime Softening
- WW : Primary & Tertiary Clarification
- IWW / PW : Carbonate removal, Metal Precipitation, Colour removal



**Features:**

- Compact, Versatile & robust
- Inbuilt Thickener
- Very efficient
- High Quality Water
- Multiple applications



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Slide 5

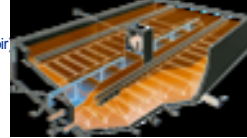
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## Pulsator™ Clarifier

*Pulsating sludge blanket type clarifier*

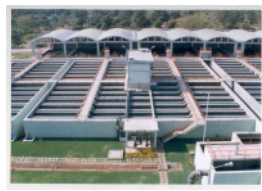
**Typical applications :**

- Raw Water Clarification (River, Dam, Reservoir)
- Clarification of Water with Algae



**Features:**

- Modular & robust process
- Rectangular Flat Bottom RCCTank
- No underwater moving parts
- Even water distribution over entire bottom
- Even sludge withdrawal across the tank



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## AquaDAF™ Clarifier

High-Rate Dissolved Air Flotation Technology by Degremont

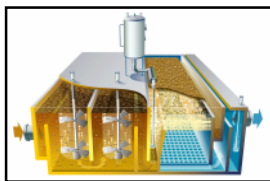
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## AquaDAF™ Water Clarifier

*Dissolved Air Flotation process*

**Typical applications:**

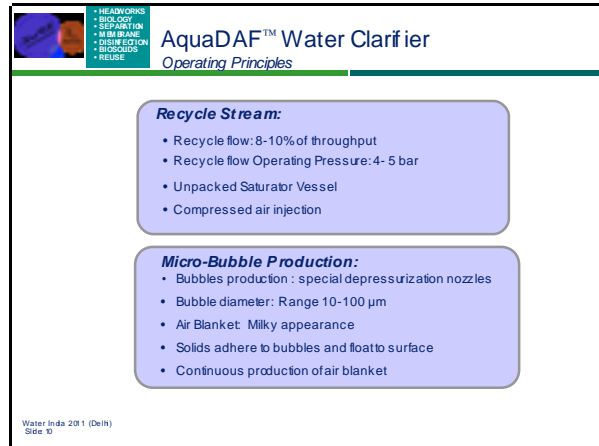
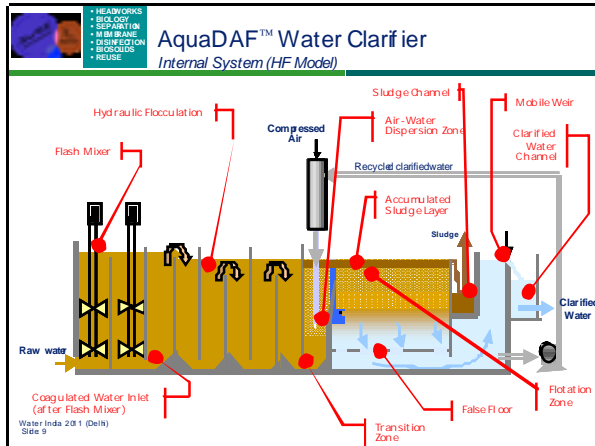
- Clarification of low turbidity waters
- Water with low density solids (i.e. Algae, etc)
- Water with high TOC
- Cold waters; Thermal variation
- pretreatment before Membrane filtration



**Features:**

- Simple & robust process
- Very small footprint
- Modular
- Polymer not necessary

Water India 2011 (Delhi)  
Slide 8



**AquaDAF™ Water Clarifier**  
Advantages

- **Flexible & Robust :**
  - treats water with temperature >3°C
  - best solution for low turbidity /high algae raw water
  - adapts to occasional peaks of TSS or Turbidity upto 200 NTU.
- **Cost effective :**
  - Reduction in the time required for the response to 5 min
  - Decrease the size of footprint while retaining its performance.
- **Easy to operate :**
  - Easy to operate and maintain (very few mechanicals, no lamella modules, no clogging)
  - No need to add material to weigh down the flocs.
  - Instantaneous Start and Stop.

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Slide 11

**AquaDAF™ Water Clarifier**  
Major References worldwide

• USA - Seneca	23 MLD
• USA - South San Joaquim	34 MLD
• FRANCE - St Brieux	35 MLD
• CANADA - Gatineau	44 MLD
• CHINA - Macao	60 MLD
• FRANCE - Apremont	72 MLD
• USA - White Tanks	77 MLD
• USA - Lake de Forest	80 MLD
• CHILE - Minera Escondida	92 MLD (sea water)
• CHINA - Qin Gzhen	106 MLD
• BRAZIL - Manaus	285 MLD
• SPAIN - Barcelona	480 MLD (sea water)
• BAHRAIN - Al Dur	575 MLD (sea water)
• INDIA - Bangalore	600 MLD (u/c)
• USA - Howarth, NJ	770 MLD (u/c)

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**AquaDAF™ Water Clarifier**  
TK Halli WTP, Bangalore - Project Fact Sheet

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• <b>Client :</b>	Bangalore Water Supply and Sewerage Board
• <b>Location :</b>	TK Halli (~85 km from Bangalore city)
• <b>Objective :</b>	Drinking water production for Bangalore city and suburbs
• <b>Raw water source :</b>	River Cauvery, from Shiva Balancing reservoir
• <b>Treatment Line :</b>	<b>Water Line :</b> Cascade Aerator + Prechlorination + Flash Mixer (with alum) + <b>AquaDAF</b> Clarifier + <b>Aquazur VR</b> Rapid Gravity Sand Filter + Postchlorination <b>Sludge Line :</b> Sludge Thickener + Mechanical Dewatering
• <b>Commissioning :</b>	Jan-Feb 2012

• **Main drivers in technology selection**

- **Highly Rocky Terrain**, hence small footprint for fast & optimum construction cost
- **Low turbidity water, but with spikes**
- **Light solids**, requiring high chemical consumption for clarification by settling
- **Algae**, incidental increase in algae in raw water affecting the filters
- **Direct Filtration** mode operation when Turbidity < 5 NTU (to optimise OPEX)

Water India 2011 (Delhi)  
Slide 5

**AquaDAF™ Water Clarifier**  
TK Halli WTP, Bangalore - Project Fact Sheet

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• **AquaDAF HF30** 10 units x 90 m<sup>2</sup> each  
28 m<sup>3</sup>/m<sup>2</sup>.hr design clarification rate  
Flocculation – Hydraulic  
Hydraulic Desludging – by Mobile Weir on clarified water side  
Footprint= 4,000 m<sup>2</sup> <<<1/4<sup>th</sup> of area reqd. by *Lamella Clarifier* >>>

Design Performance	AquaDAF	Overall Plant
Plant treatment capacity	600 MLD	600 MLD
Raw water quality (turbidity)	20 NTU (90%iles), 100 max.	-
Water loss	-	< 2%
Treated water quality (turbidity)	< 5 NTU (typically < 2 NTU)	< 0.5 NTU
Longer Filter runs	-	72 hrs (3 days)

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**AquaDAF™ Water Clarifier**  
TK Halli WTP, Bangalore – Project Fact Sheet

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• SEPARATION  
• MEMBRANE  
• DISINFECTION  
• BIOGAS  
• REUSE

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**AquaDAF™ Water Clarifier**  
Photo Gallery


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• SEPARATION  
• MEMBRANE  
• DISINFECTION  
• BIOGAS  
• REUSE

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Slide 9


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- SEPARATION
- MEMBRANE
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**AquaDAF™ Water Clarifier**  
 – Photo Gallery


Airwater saturator



False floor



Nozzles for microbubbles production




Water India 2011 (Delhi) Side 7'

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**AquaDAF™ Water Clarifier**  
 – Photo Gallery

Uniform Air Blanket: Milky appearance




Water India 2011 (Delhi) Side 8

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**AquaDAF™ Water Clarifier**  
 – Photo Gallery

Floating Sludge Formation




Water India 2011 (Delhi) Side 9


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**AquaDAF™ Water Clarifier**  
 – Photo Gallery


Clarified Water under Floating Sludge



Floating Sludge



Hydraulic Desludging



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Thank you...

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Side 2

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 • DISINFECTION  
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Side 2

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### AquaDAF™ Water Clarifier

*Key to High-Rate Operation*

DAF System + Special False Floor = High-Rate AquaDAF Clarifier

As loading rate on a conventional system increases there is a tendency for short-circuiting and turbulence to be met on panels. This can lead to solids carry over.

In AquaDAF, a special false floor is constructed (Plastic/wooden panels) with a special hole pattern. It introduces flow resistance and promotes uniform flow distribution.

Headloss across the floor creates a circular flow pattern. The highly concentrated bubble blanket is maintained in the float area at rates of 20 m<sup>3</sup>/m<sup>2</sup>/hr and higher.

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Side 2

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 • SEPARATION  
 • MEMBRANE  
 • DISINFECTION  
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### AquaDAF™ Water Clarifier

*Key to High Rate Operation*

#### Special False Floor:

- Irregular hole pattern
- Headloss across floor creates a circular flow pattern within basin
- Introducing flow resistance to create uniform flow distribution
- Highly concentrated bubble bed maintained within float area
- Enhanced coalescing of sludge
- High clarification rates: 25 to 40 m<sup>3</sup>/m<sup>2</sup>/hr

CFD Model

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Side 2