Energy efficiency and capacity increase

IFAS (integrated fixed film activated sludge) **textile fixed bed**

combined with

Ultra fine bubble aeration

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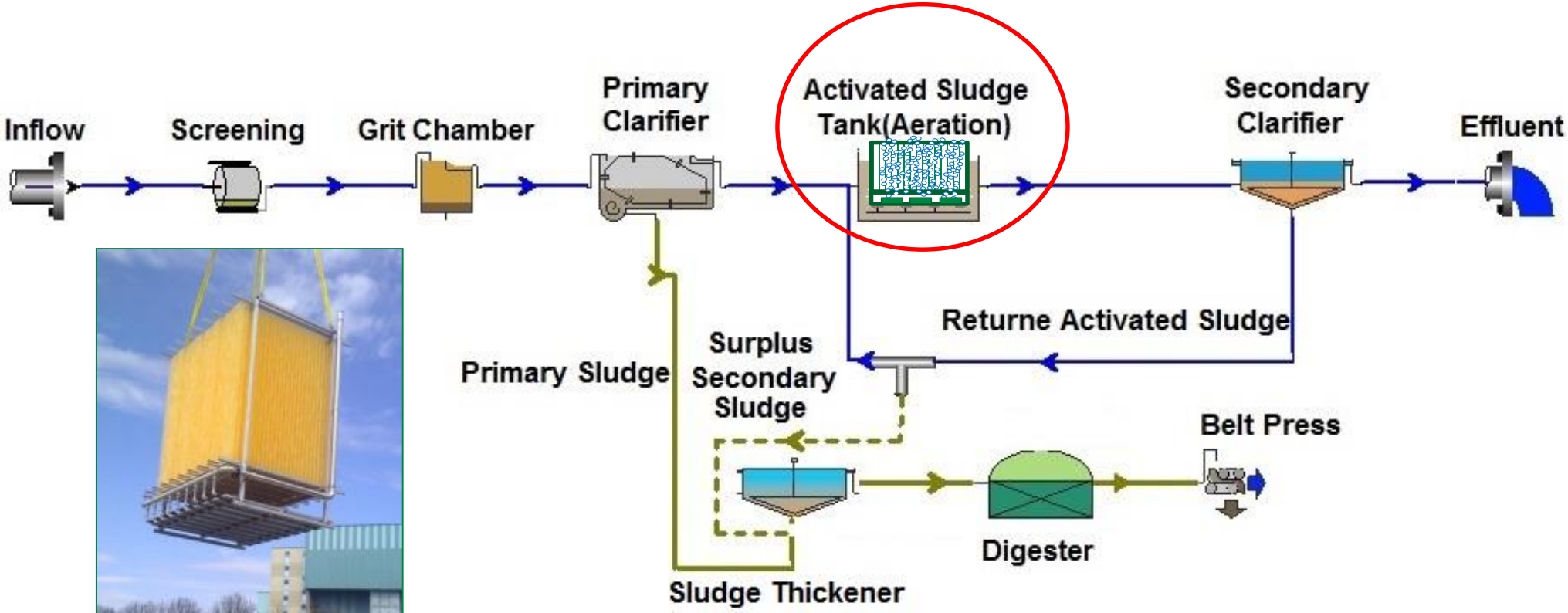
WWTP – Flow Chart



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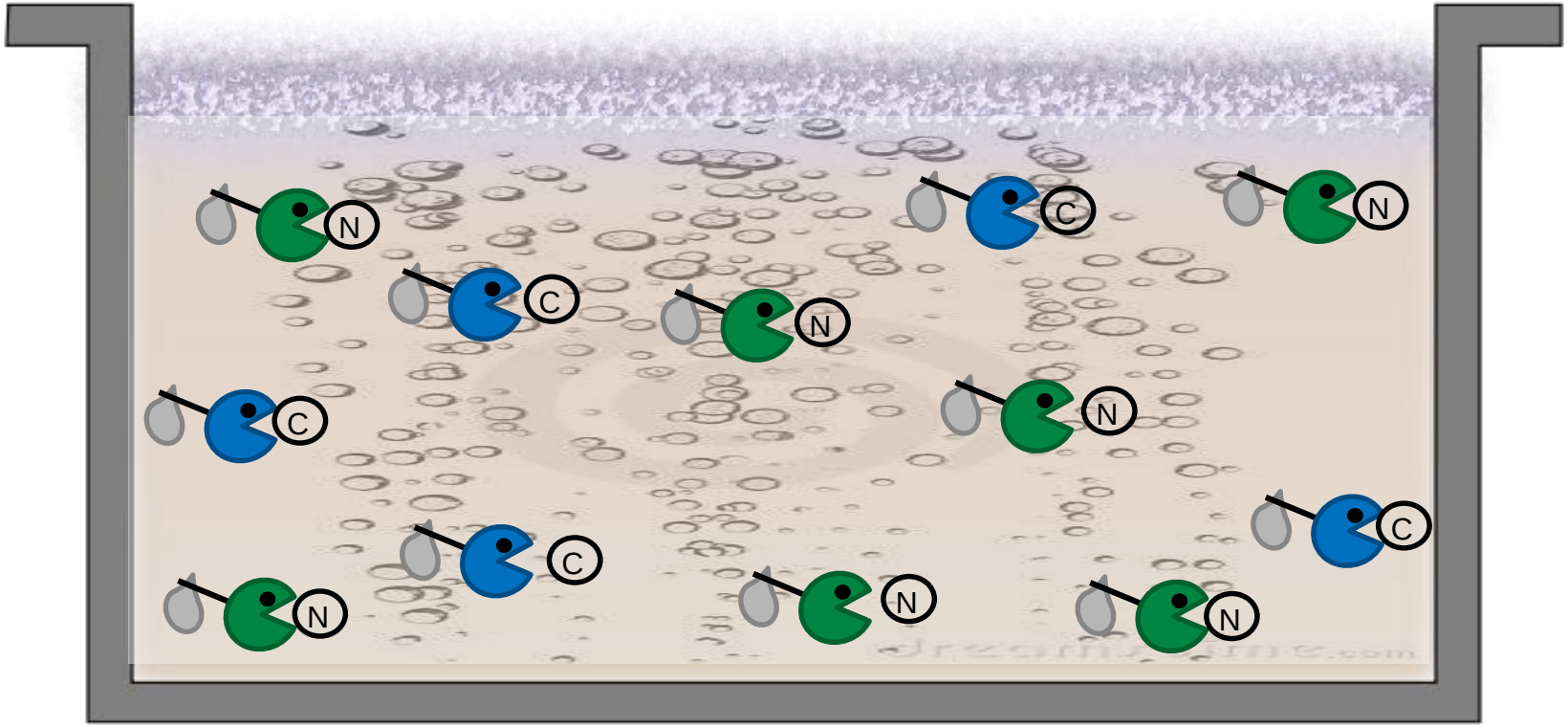
WWTP - Biological Stage



Conventional Activated Sludge Tank with suspended Biomass

Suspended heterotrophe
(for C-Elimination)

Suspended autotroph
(for Nitrification)

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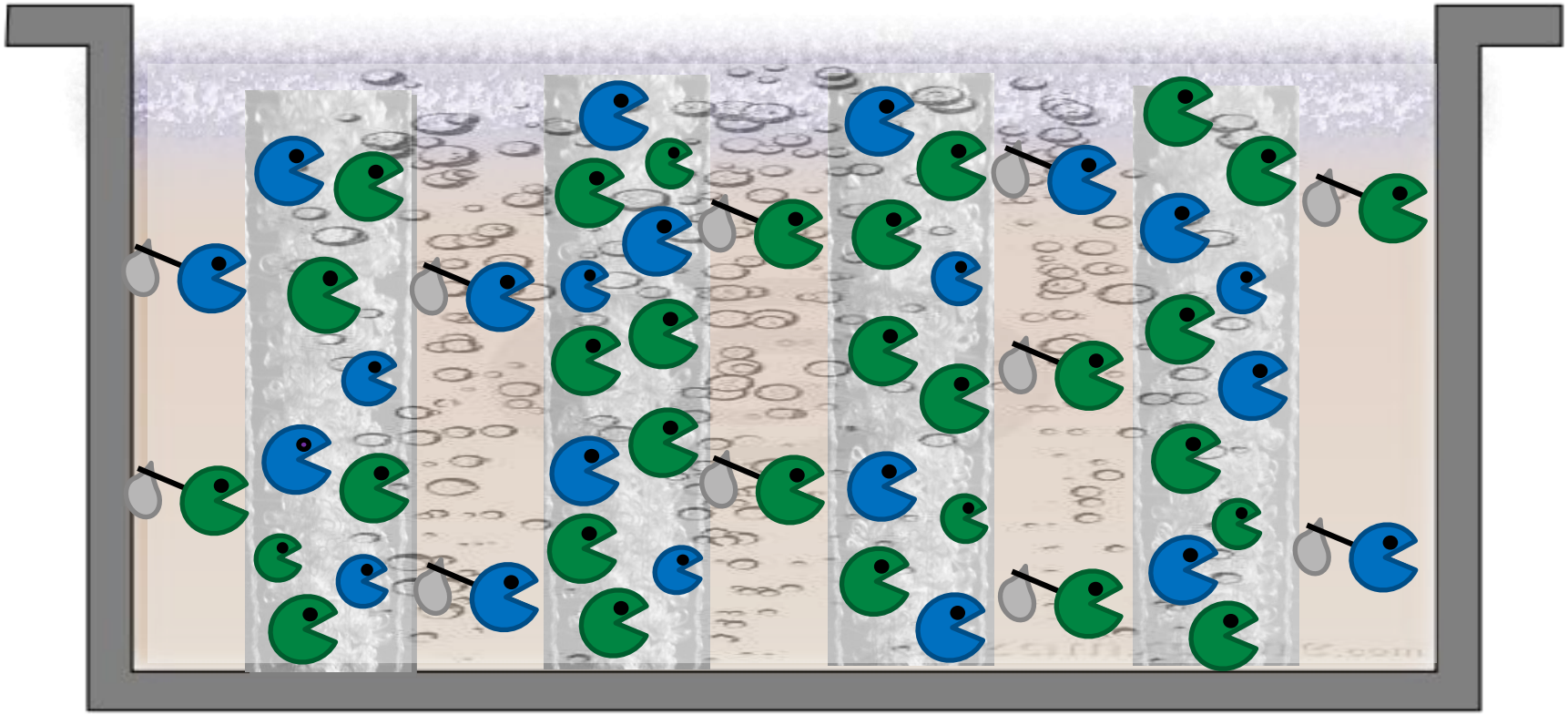
IFAS – Explanation



IFAS process (Integrated Fixed Film Activated Sluge) Activated Sludge tank with Cleartec System

suspended combined with sessile biomass

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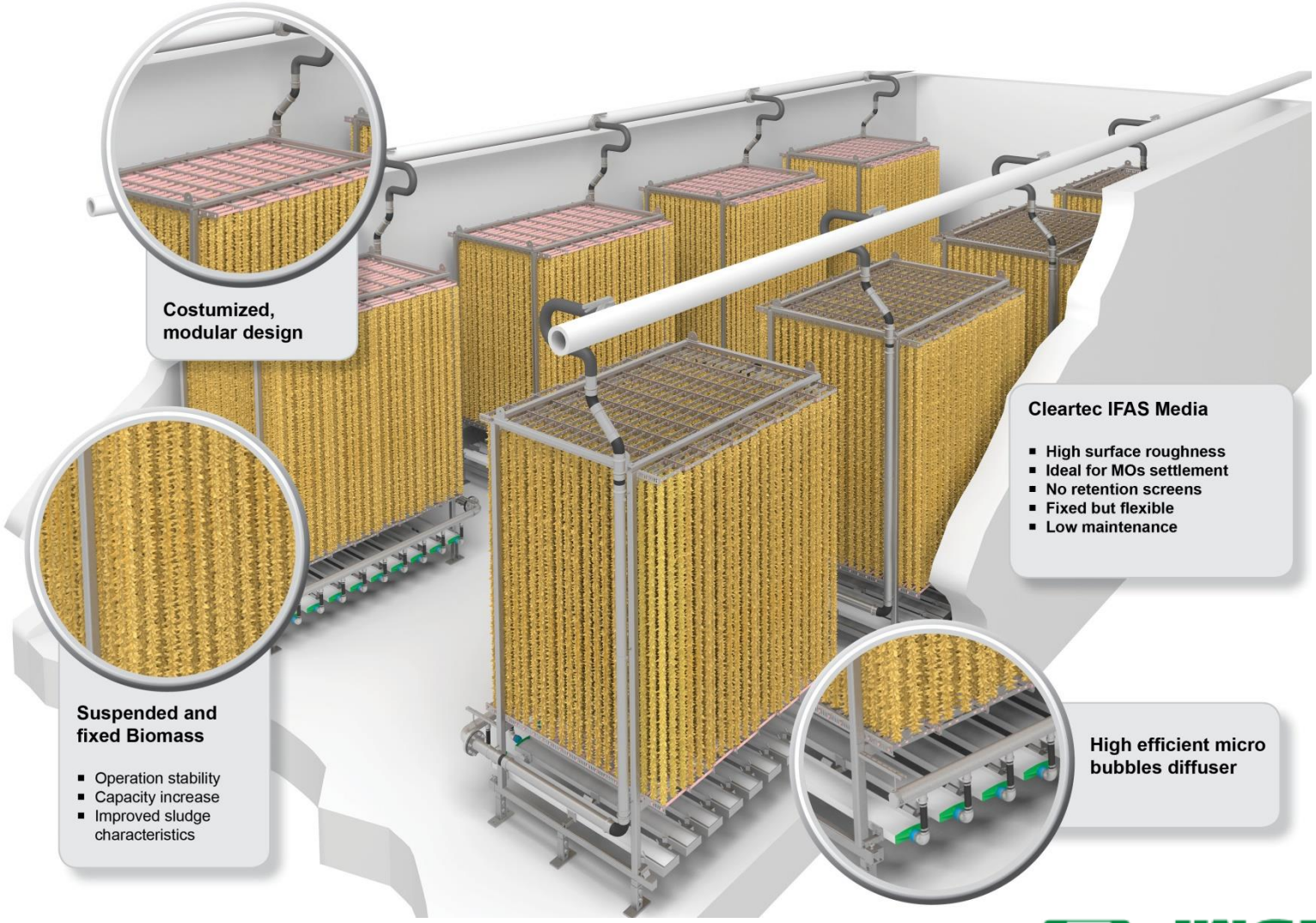
IFAS textile fixed bed combined with ultra fine bubble aeration



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Cleartec – a closer look

1 Growth stripes

2 Biofilm, sessile biomass

3 Flexibility

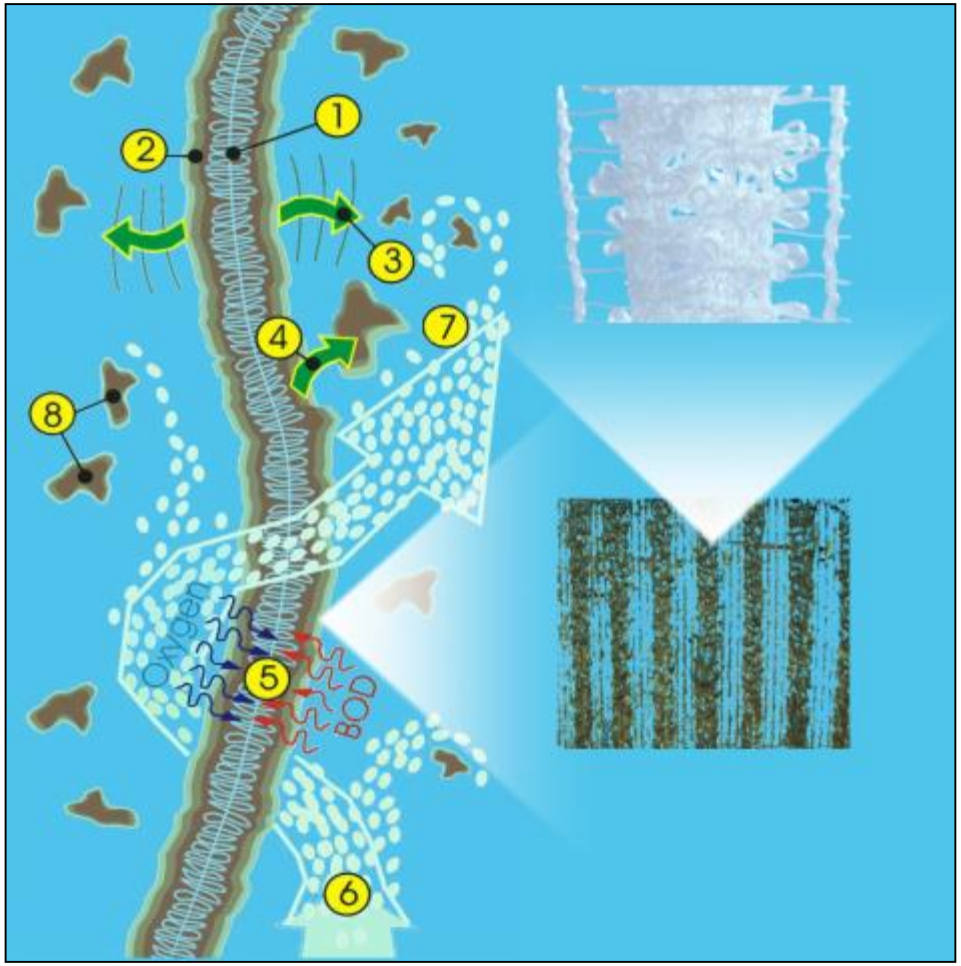
4 removal of old biomass

5 bacterial metabolism processes

6 aeration

7 vertical flow

8 suspended biomass



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Textile fixed bed: 2 basic materials

- 3-dimensional BioCurlz
  - 6 laces per unit
  - Specific surface: 32m²/m²
- 2-dimensional BioTextile
  - flat woven fabric
  - Specific surface: 23m²/m²

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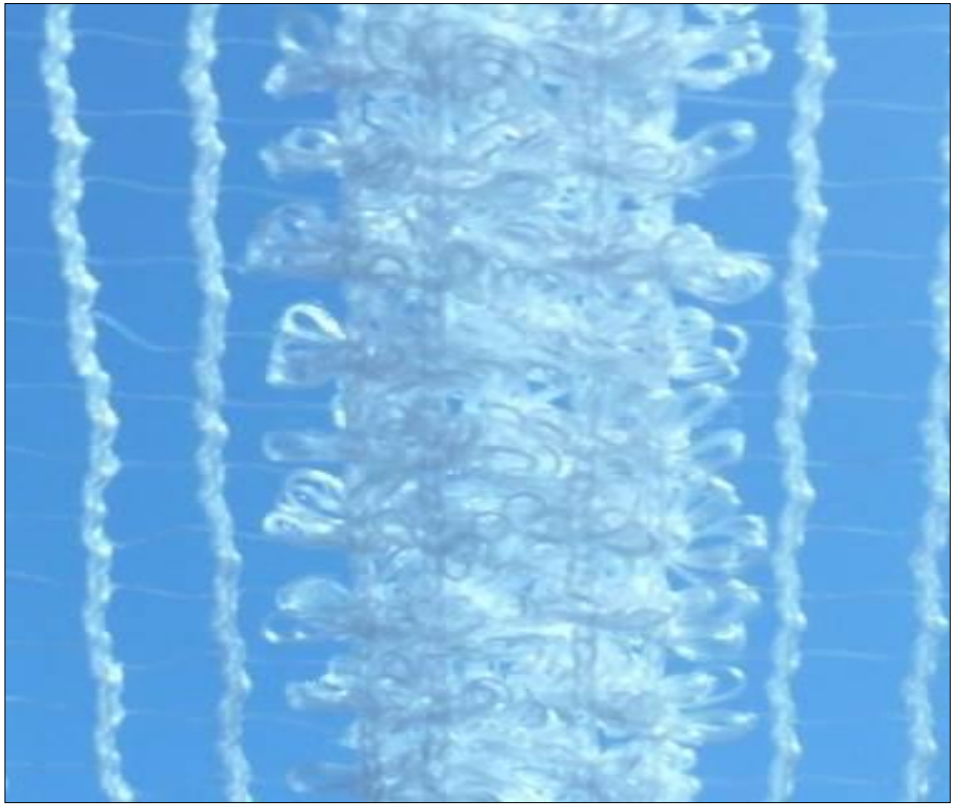
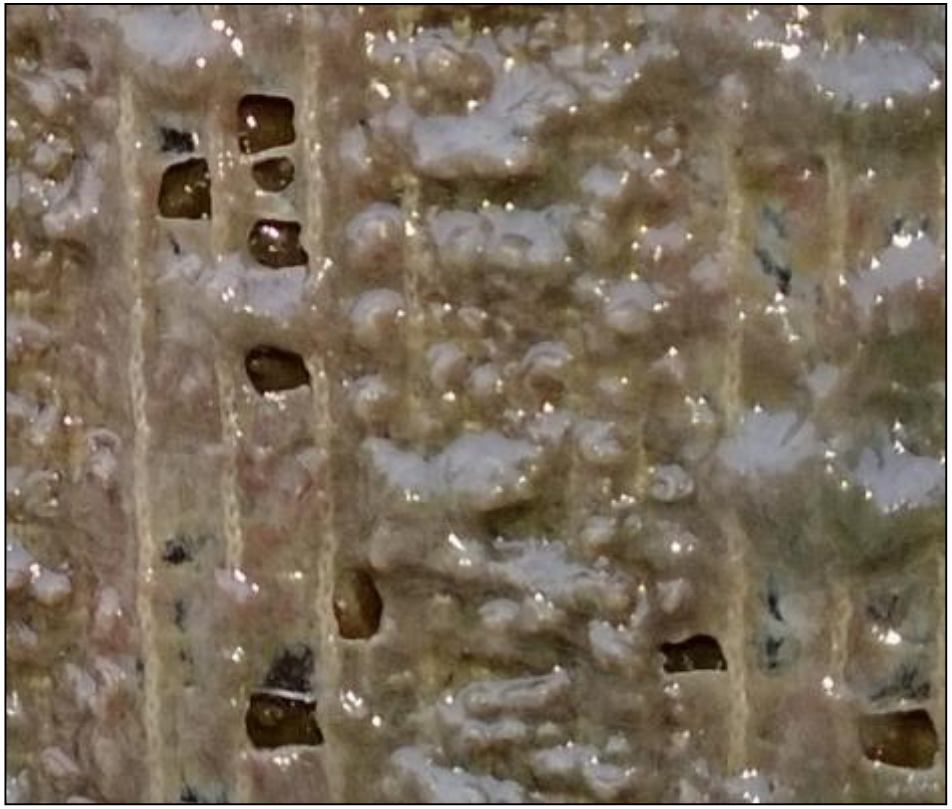
2-dimensional Cleartec - fabric





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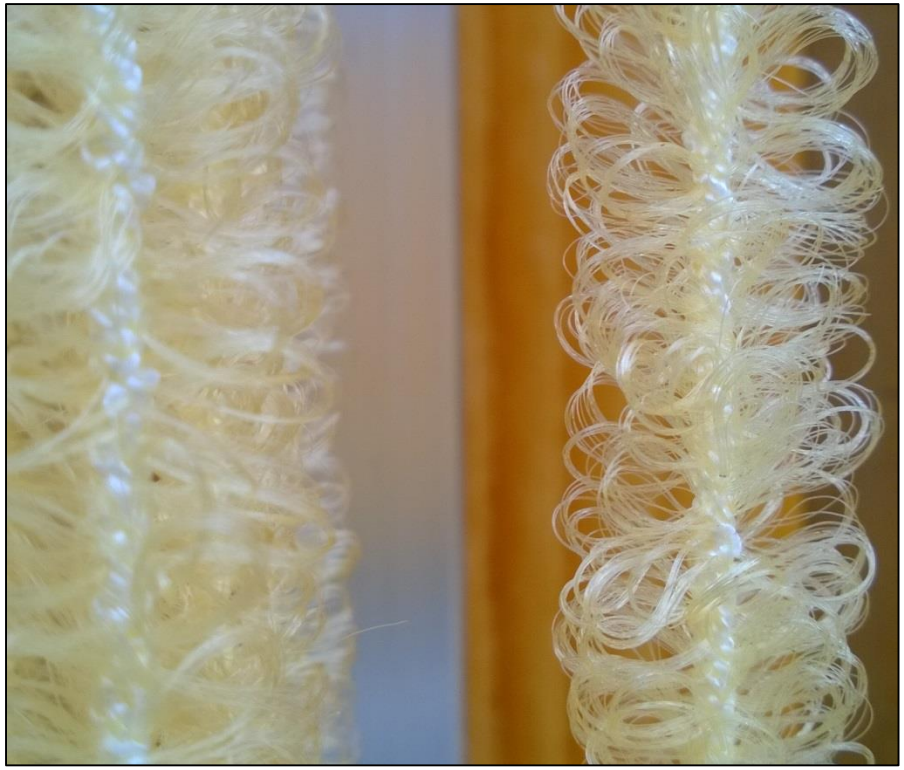
3-dimensional BioCurlz



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IFAS Cleartec Biotextile (1)

- Significant expansion (up to 100%) with little or no additional aerobic volume
  - Increased Biological Nutrient Removal (BNR)
  - Improved solids settling (typical SVI's less than 80)
- Greater resistance to hydraulic solids washout
- Increased resilience to shock loading
- Reduced solids flow to clarifiers, increasing clarifier capacity
- Up to 50% less energy than other MBBR/Moving Bed IFAS systems
  - MBBR: OC 4-6 mg/l
  - Cleartec: OC <2 mg/l

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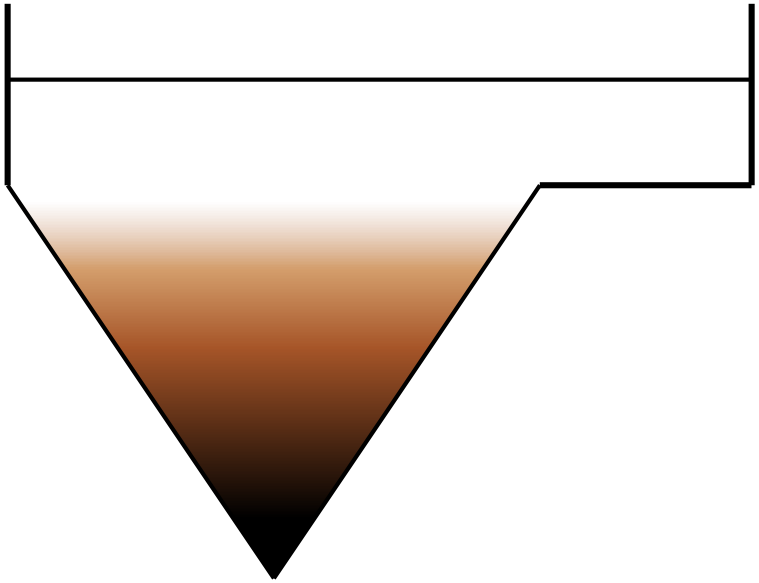
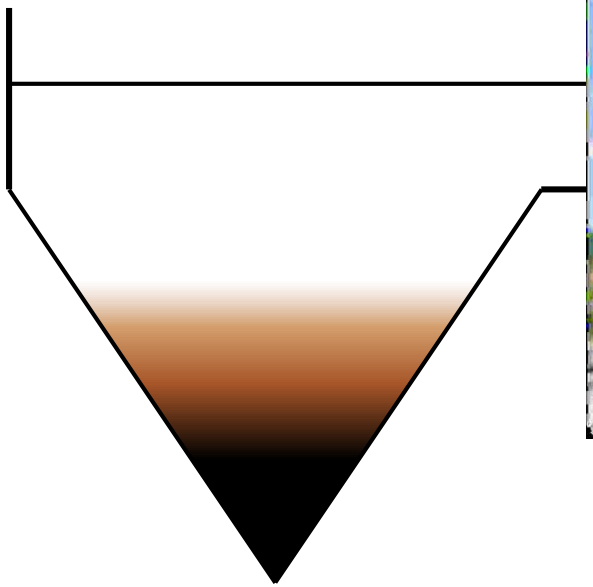
IFAS impact on FST

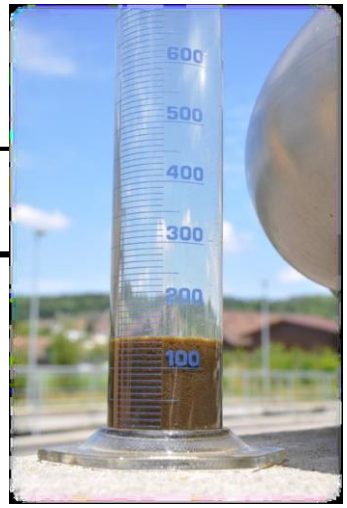
Sludge from convantional AST
SVI 120 - 150



Normal settlement of Sludge

Sludge form IFAS AST
SVI 70 – 100





Faster settlement, more sludge can be returned in less time

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Comparison MBBR vs. Cleartec IFAS technology

The nature of the Cleartec fixed-bed system results in effective treatment without the concerns associated with moving bed systems.

- No Media Migration in basins or Media Loss into the discharge waters
- No Additional Aeration Energy required for Mixing
- No requirement for fine screening
- No degradation to sludge settle ability

		MBBR Moving bed reactor	**Cleartec® textile installed in SS frames with integrated aeration**
Technical description	Material	small moving polymer carriers, cylindrical shaped, foamed	Polypropylen filaments woven to 3D laces or2D fabric
	Installation	movable, free floating	flexible, fixed cages with integrated aerators
Aeration system	Type of aerators	coarse - fine bubble	fine - mirco fine bubble
	Energy consumption	High, high airflow required to prevent settlement of carriers OC > 5 mg/l	Low, low airflow to control thickness of biofilm OC 1,2 - 1,8 mg/l
	Installation	fixed, bottom mounted	retrievable, integrated in cages, can be lifted easy
	Maintenance	dewatering of tank and separation of media required	cages with textile & aerators can be lifted aside the tank, easy & safe access to aerators
Process description	Specific surface for biomass settlement	up to 1.200 m²/m³	600 - 1.000 m²/m³
	Volume displacement of fixed bed	high (70%)	very low (<10%)
	Energy consumption	high	low
	Process stability	middle - high	high
		agglomeration of carriers at outlet (downstream) fine screen required additional clarifier capacity required	High resistance agains hydraulic shock load resistant against clogging / 3D perfusion Improved slude settlement velocity/no additional clarifier capacity required
	Investment costs	low	middle

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Upgrade of WWTP Geiselbullach, Munich Germany (1)

TYPE OF WWTP	Municipal
MAXIMUM FLOW	80. 000 m³/d
CAPACITY	250. 000 PE
BIOLOGICAL STAGE	2 lanes
	2 anox tanks
	2 anaerobic tanks
	2 aerobic tanks
OPERATION	upstream denitrification
	Bio-P (additional P-precipation)
TREATMENT	Nitrification
	Denitrification
	Bio-P

Stömungs-Simulation

BioWin-Simulation

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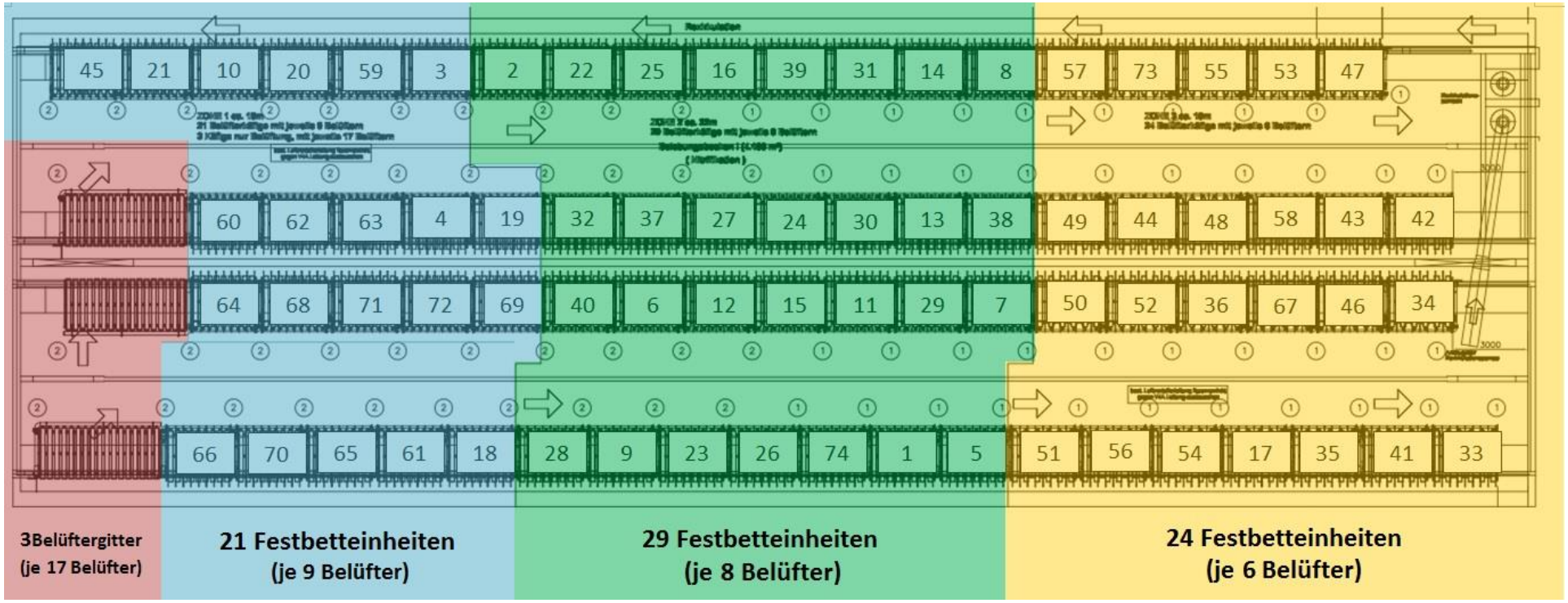
Position of the Cages in the aeration tanks



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Retrofitting of WWTP Geiselbullach, Munich Germany (2)

- 1987: Start up
- 1995: Higher legal requirements in N-elimination led the operator to experiment with different fixed-bed systems.
- 1996: Our initial development of a retiform textile media was installed.
- 2012: The IFAS system still provided the required effluent quality. But the aluminum metal cages were corroded and failed.
- 2013: After more than 17 years of operation retrofit of the complete aeration system

	1987 (without Cleartec®)			2013 (with Cleartec®)		
Parameter	**Inflow [mg/l]**	**Effluent [mg/l]**	**Biological efficiency [%]**	**Inflow [mg/l]**	**Effluent [mg/l]**	**Biological efficiency [%]**
COD	310	53	82,9	543	22	95,9
BOD_5	172	11	93,5	207	1,9	99,1
NH_4-N	36	32	11,1	32	3,04*	90,5
					0,35**	98,9

*January-December
**Mai-October (consent value by legal requirement)

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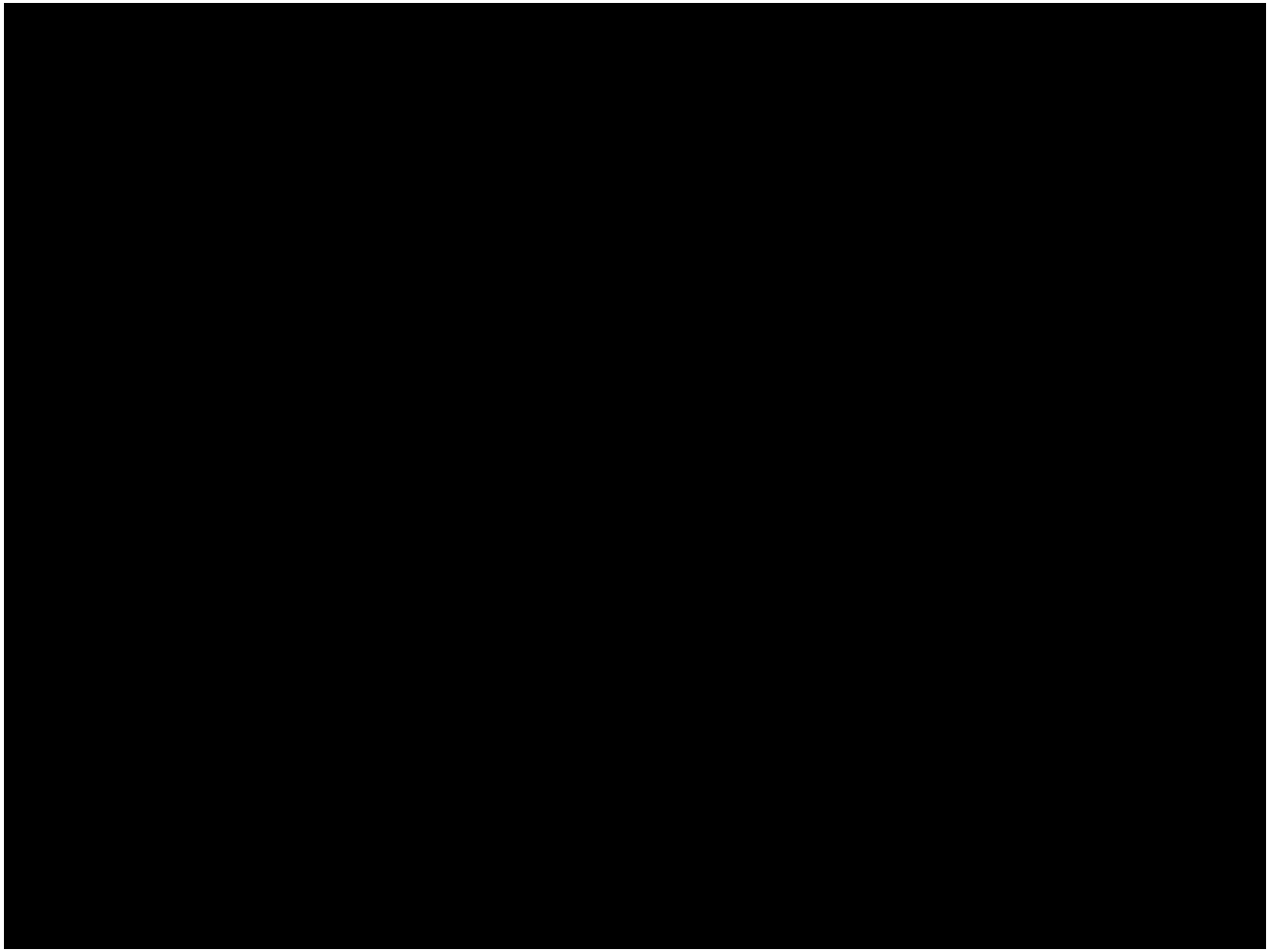
Upgrade of WWTP Geiselbullach, Munich Germany (3)



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Geiselbullach: High diffuser density equally spaced

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Geiselbullach:
Retrievable cages with IFAS textile and integrated diffusers

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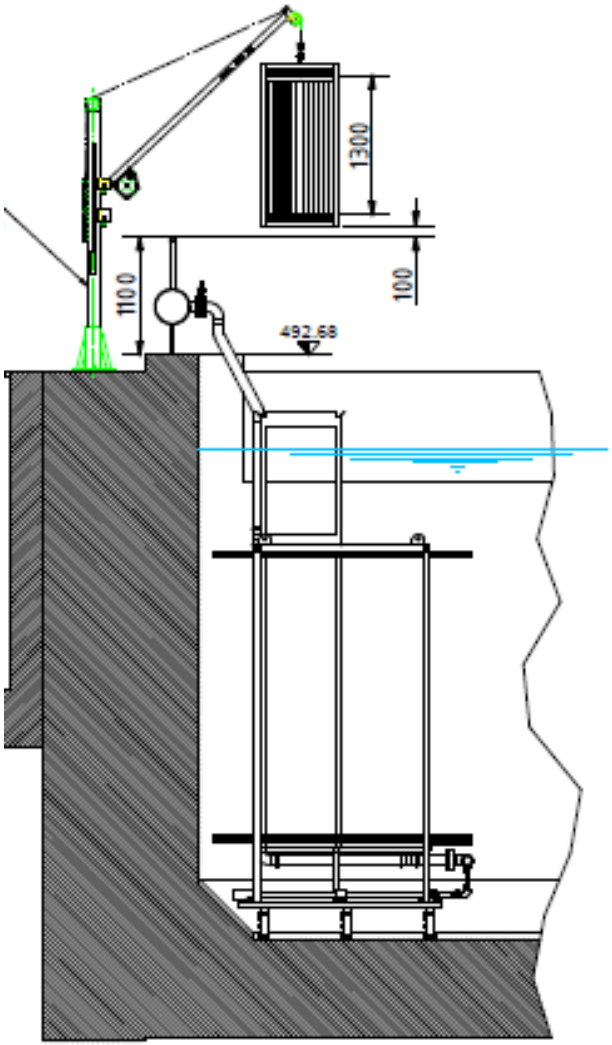
Geiselbullach: Pilot cage aeration tank



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Geiselbullach: Biofilm / sessile biomass
3 days after commissioning @ TS 6 g/l

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WWTP Geiselbullach – Results of the commisioning phase

Biofilm / sessile biomass

2 Month after contact with waste water

- Thick biofilm
- Complete flow / no blocking
- No redworms
- No EPS
- Suspended solids / TS 6 g/l

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Comparison of Aeration Systems: Surface aerators (1)

Aeration rotors ∅ 700mm

Aeration rotor ∅ 1.000mm

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Comparison of Aeration Systems: Surface Aerator (2)

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