



**Sustainable Water
Integrated Management (SWIM) -
Support Mechanism**



Project funded by
the European Union

Water is too precious to waste

TWO DAYS TRAINING ON THE OPERATION AND MANAGEMENT OF WWTPS

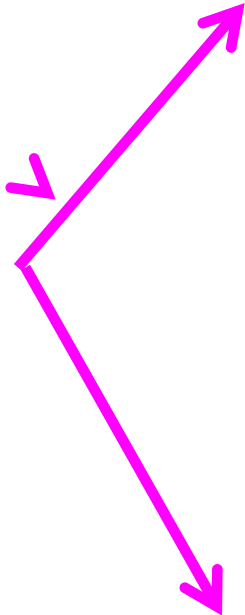
9-10 September, Murcia

Conventional and advanced tertiary treatment

Presented by: Pedro Simon Andreu

Conventional and advanced tertiary treatments

Conventional treatments

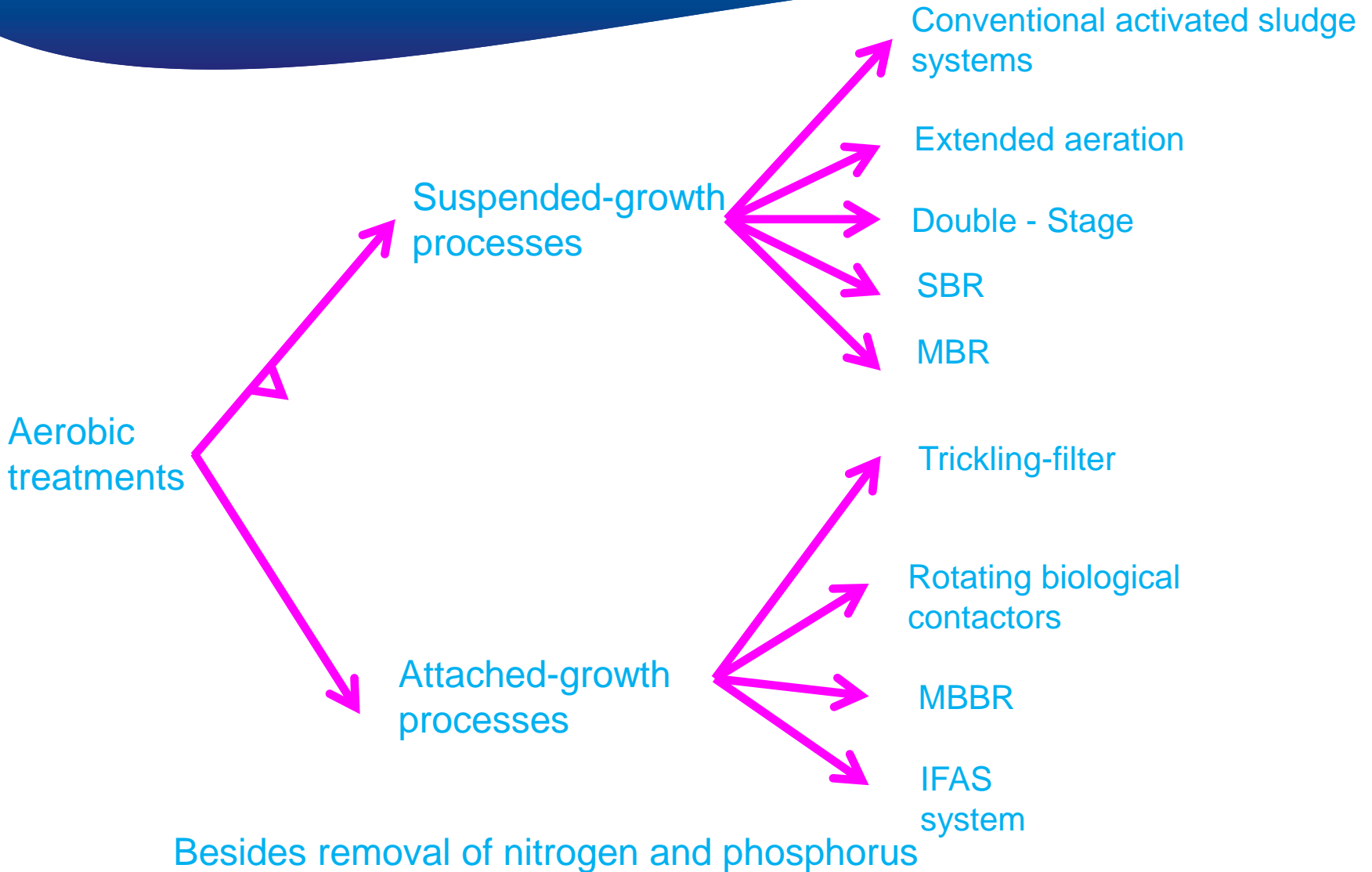


Aerobic treatment



Anaerobic treatment

Conventional and advanced tertiary treatments



Conventional and advanced tertiary treatments



Conventional activated sludge

Conventional and advanced tertiary treatments



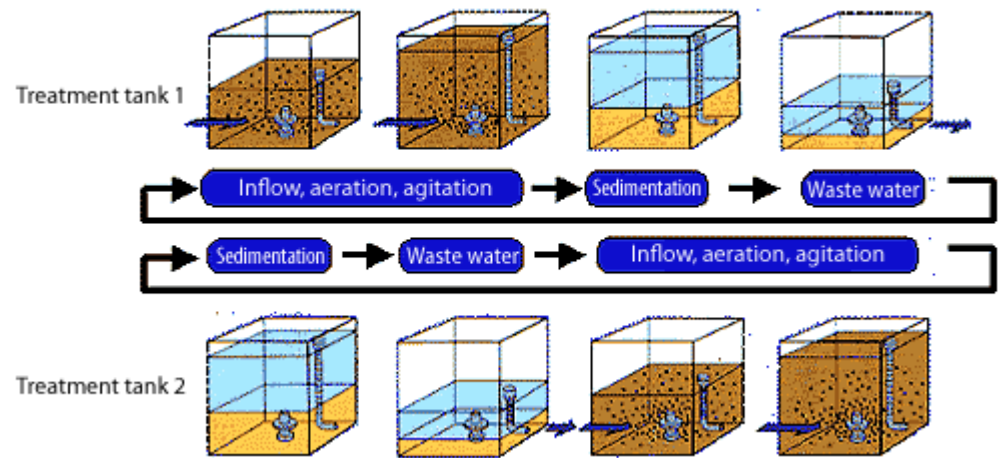
Extended aeration

Conventional and advanced tertiary treatments



Double - stage

Conventional and advanced tertiary treatments



Sequential Batch
Reactor

Conventional and advanced tertiary treatments

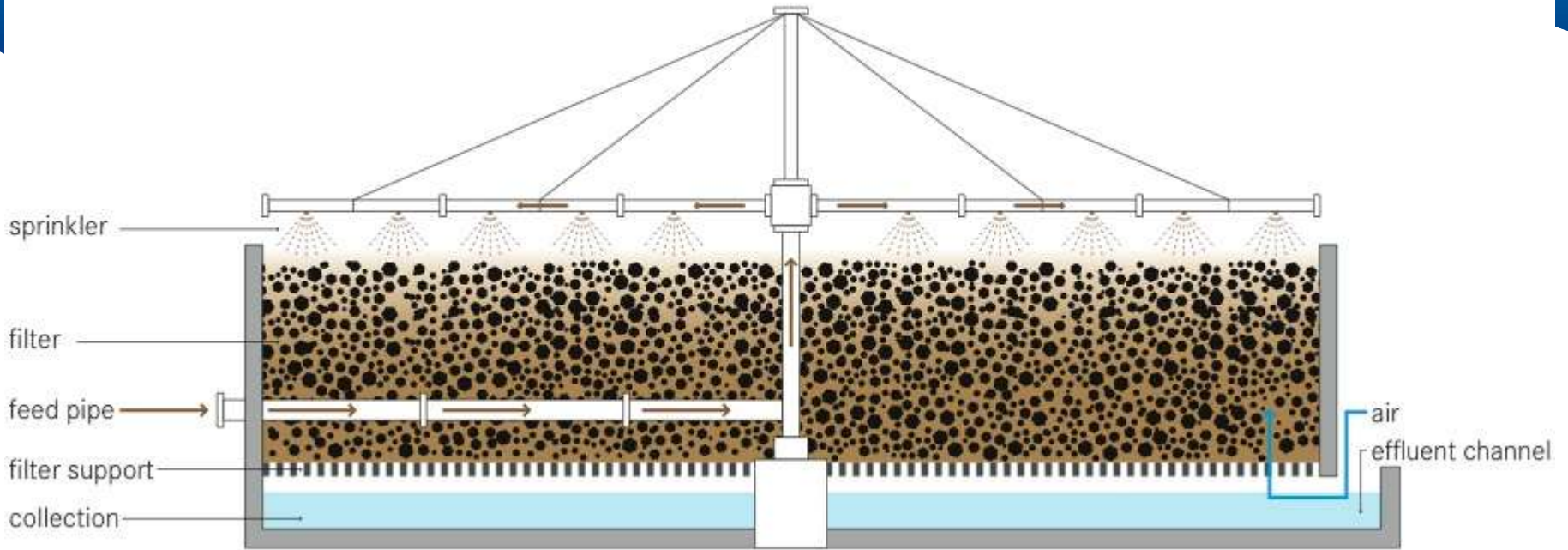


Membrane Biological
Reactor (MBR)

Conventional and advanced tertiary treatments



Conventional and advanced tertiary treatments



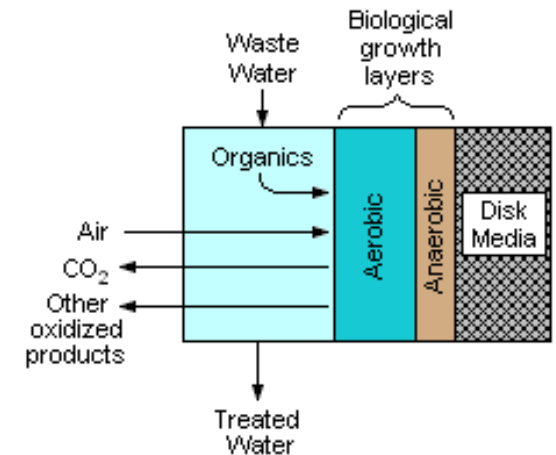
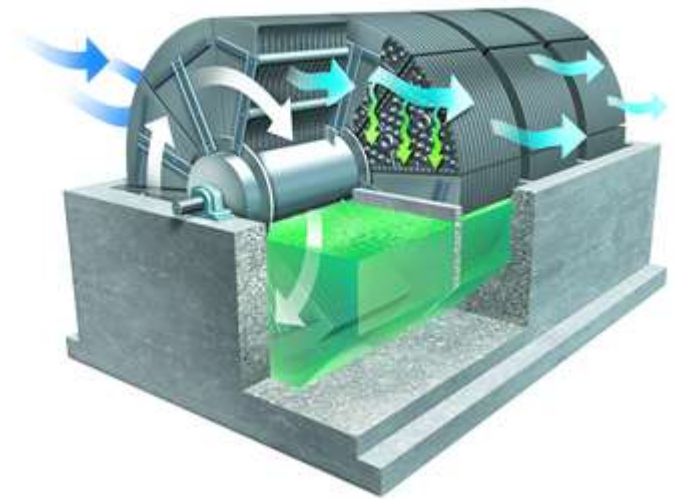
Trickling-Filter



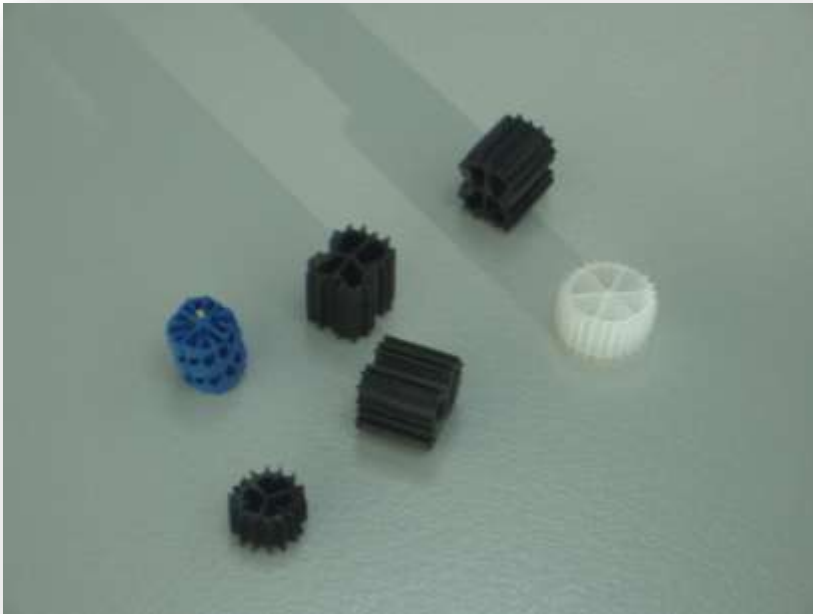
Conventional and advanced tertiary treatments



Rotating Biological Contactors



Conventional and advanced tertiary treatments



Moving Bed Biological Reactor (MBBR)

Conventional and advanced tertiary treatments



IFAS SYSTEM

Conventional and advanced tertiary treatments

Biological Treatment Processes	Facilities
Conventional Activated Sludge	6
Extended Aeration	70
Double Stage	3
MBR	7
Lagooning	1
RBC	1

Number of Murcia Region wastewater treatment facilities by
Biological Process

Conventional and advanced tertiary treatments

WWTP Range	Facilities number	Treated volume (m ³ /year)	%
≤ 500 p.e.	22	377.846	0,35
500 - 2.000 p.e.	22	1.354.592	1,24
2.000 - 20.000 p.e.	22	19.038.591	17,4
20.000 - 100.000 p.e.	19	34.387.240	31,43
≥100.000 p.e.	3	54.248.405	49,58
TOTAL	88	109.406.674	100

Conventional and advanced tertiary treatments

Construction Cost

WWTP	Construction cost (€)	Building year	Capacity (m3/day)	Treatment
Abanilla	1.178.638	2001	1500	E.A.+Ph-Ch+SF+UV
Barinas	1.201.615	2008	540	E.A.+RF
Alhama	3.376.069	2003	5400	E.A.+SF+UV
Beniel	4.646.400	2005	5000	E.A.+Ph-Ch+SF+UV
Caravaca	6.552.557	2005	8000	E.A.+Ph-Ch+SF+UV
Ceuti	5.605.258	2007	8000	E.A.+Ph-Ch+RF+UV
Jumilla	7.721.835	2007	12000	E.A.+Ph-Ch+SF+UV
Lorquí	4.719.755	2006	5000	E.A.+Ph-Ch+SF+UV
Mazarrón	6.618.273	2004	15000	E.A.+Ph-Ch+RF+UV
Moratalla	4.411.500	2005	4500	E.A.+Ph-Ch+SF+UV
Mula	5.164.800	2007	6000	E.A.+Ph-Ch+DF+UV
San Javier	17.541.300	2007	22500	E.A.+Ph-Ch+SF+UV
Torrepacheco	4.006.572	2004	5000	E.A.+Ph-Ch+SF+UV
Torres de Cotillas	7.963.328	2007	12000	E.A.+Ph-Ch+SF+UV
Los Alcázares	15.415.765	2008	22500	E.A.+Ph-Ch+SF+UV
San Pedro	13.410.000	2007	20000	MBR
Cabezo Beaza	15.276.314	2001	35000	CAS
Murcia Este	40.992.300	2000	100000	CAS (A2O modified)

Where:

CAS: Conventional Activated Sludge

E.A.: Extended Aeration

Ph-Ch:Physical-Chemical Process

SF: Sand Filter

RF: Ring Filter

DF: Disc Filter

Conventional and advanced tertiary treatments

Level of treatment	Number of facilities	Treated Volume (Hm ³ /year)	%
Tertiary Treatment	53	49,98	45,68%
Secondary Treatment	34	57,953	52,97%
Lagooning	1	1,511	1,38%
	88	109,407	100%

Conventional and advanced tertiary treatments



Segura River mouth

Conventional and advanced tertiary treatments

Unit process for complying with Reuse Legislation

➤ Suspended Solids



➤ Turbidity

➤ Escherichia Coli

➤ Helminth eggs

Filtration

Physical-Chemical
process and filtration

Filtration + Disinfection

Filtration

Conventional and advanced tertiary treatments



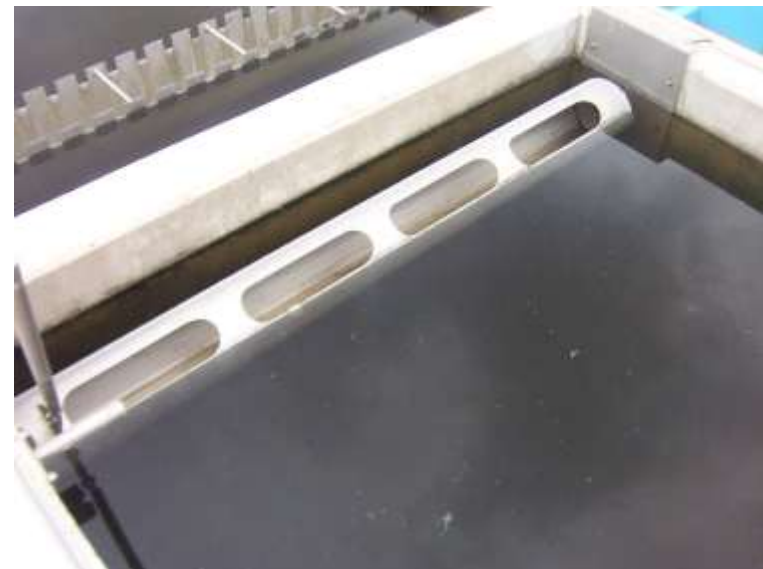
Flow equalitation tank

Conventional and advanced tertiary treatments



Algae Problem

Conventional and advanced tertiary treatments



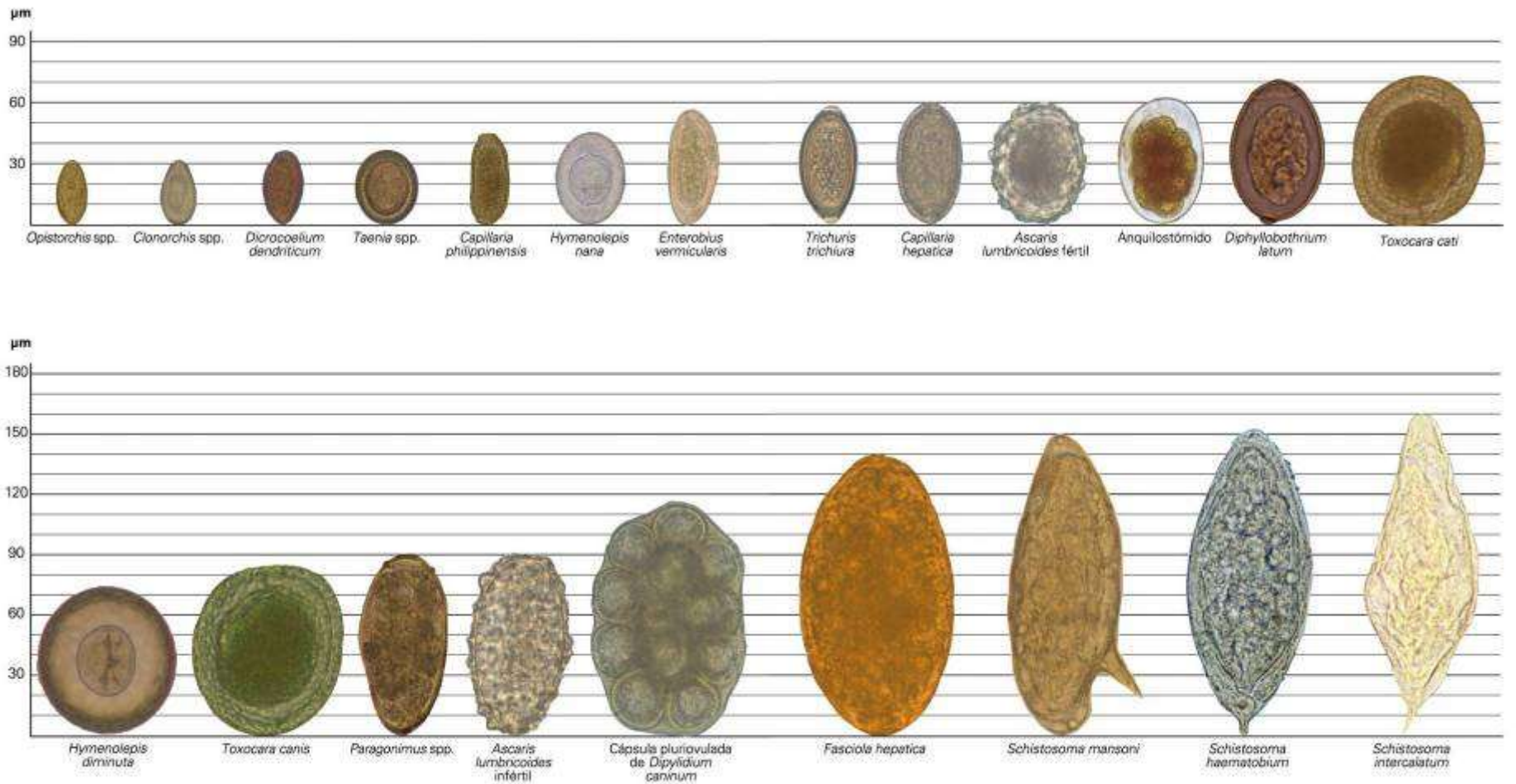
Physical-Chemical Process
(coagulation and flocculation)

Conventional and advanced tertiary treatments



Lamella tube settler

Conventional and advanced tertiary treatments



Size of helminth eggs

Conventional and advanced tertiary treatments



Sand Filter



Conventional and advanced tertiary treatments

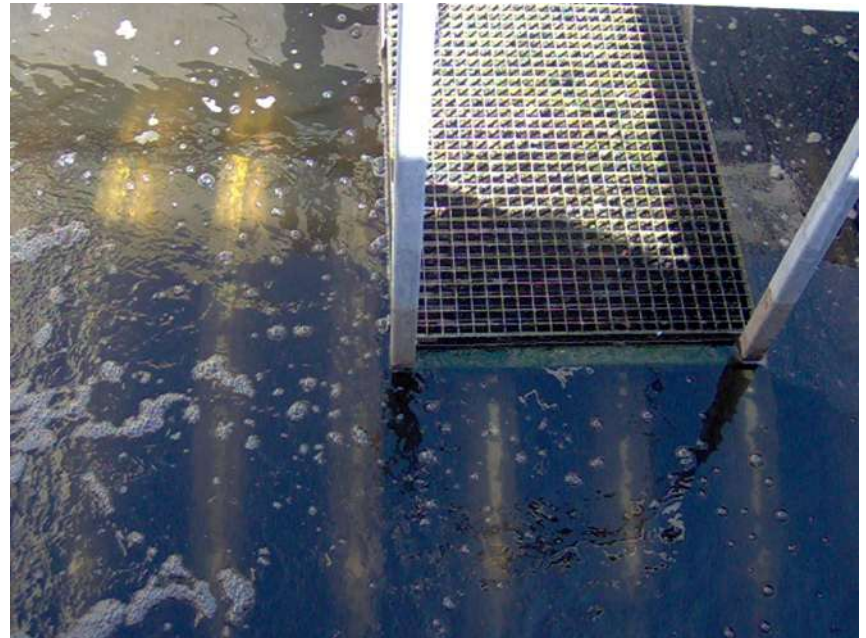


Continuous Cleaning sand filter

Conventional and advanced tertiary treatments



Cloth Filter



Conventional and advanced tertiary treatments



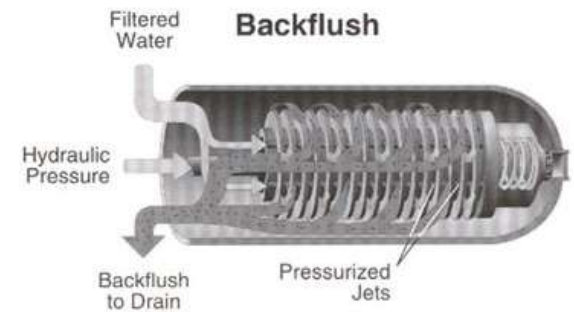
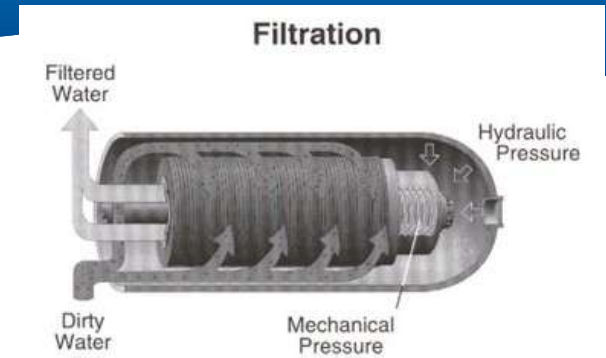
Membrane Disc Filter



Conventional and advanced tertiary treatments



Ring- Filter



Conventional and advanced tertiary treatments



Sand Filter

Conventional and advanced tertiary treatments



Sand Filter Problems

Conventional and advanced tertiary treatments



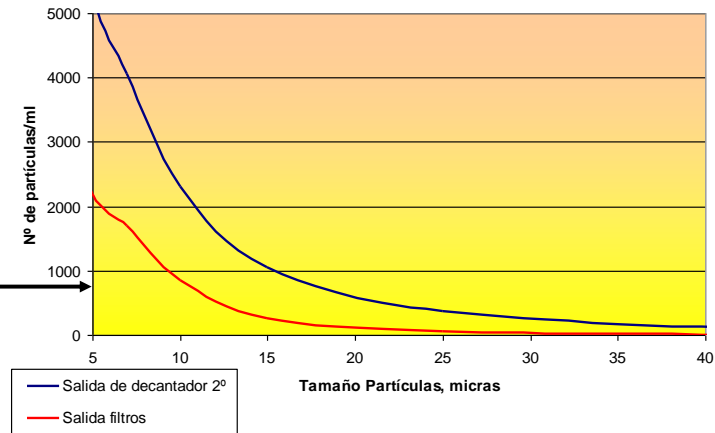
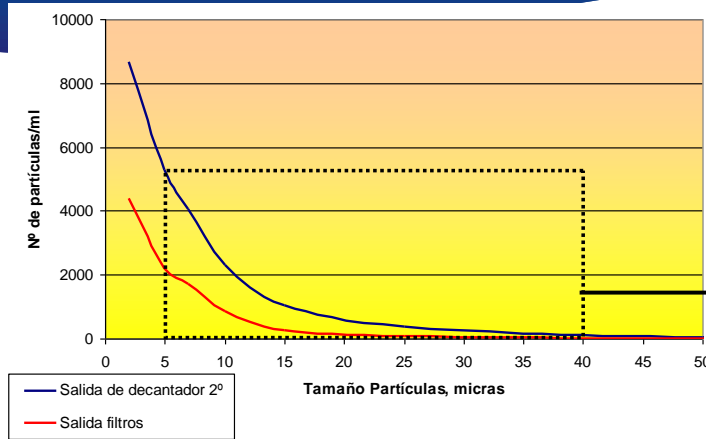
Sand Filter Problems

Conventional and advanced tertiary treatments

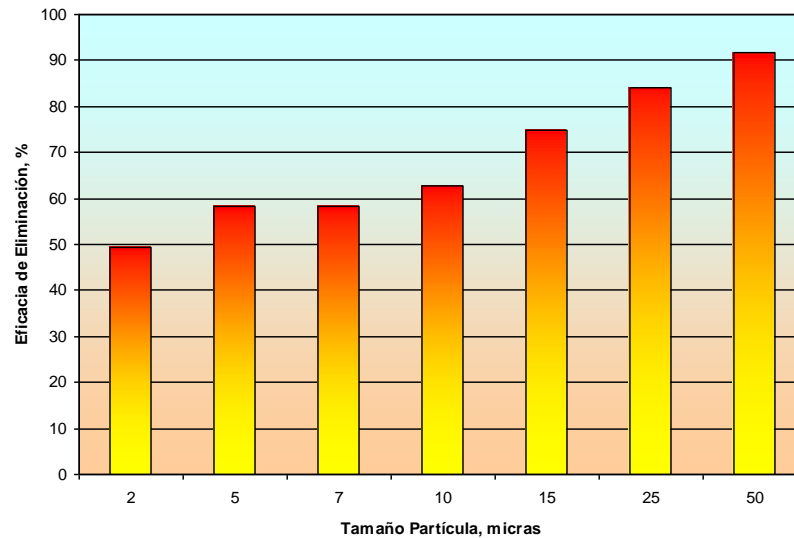


Leopold System

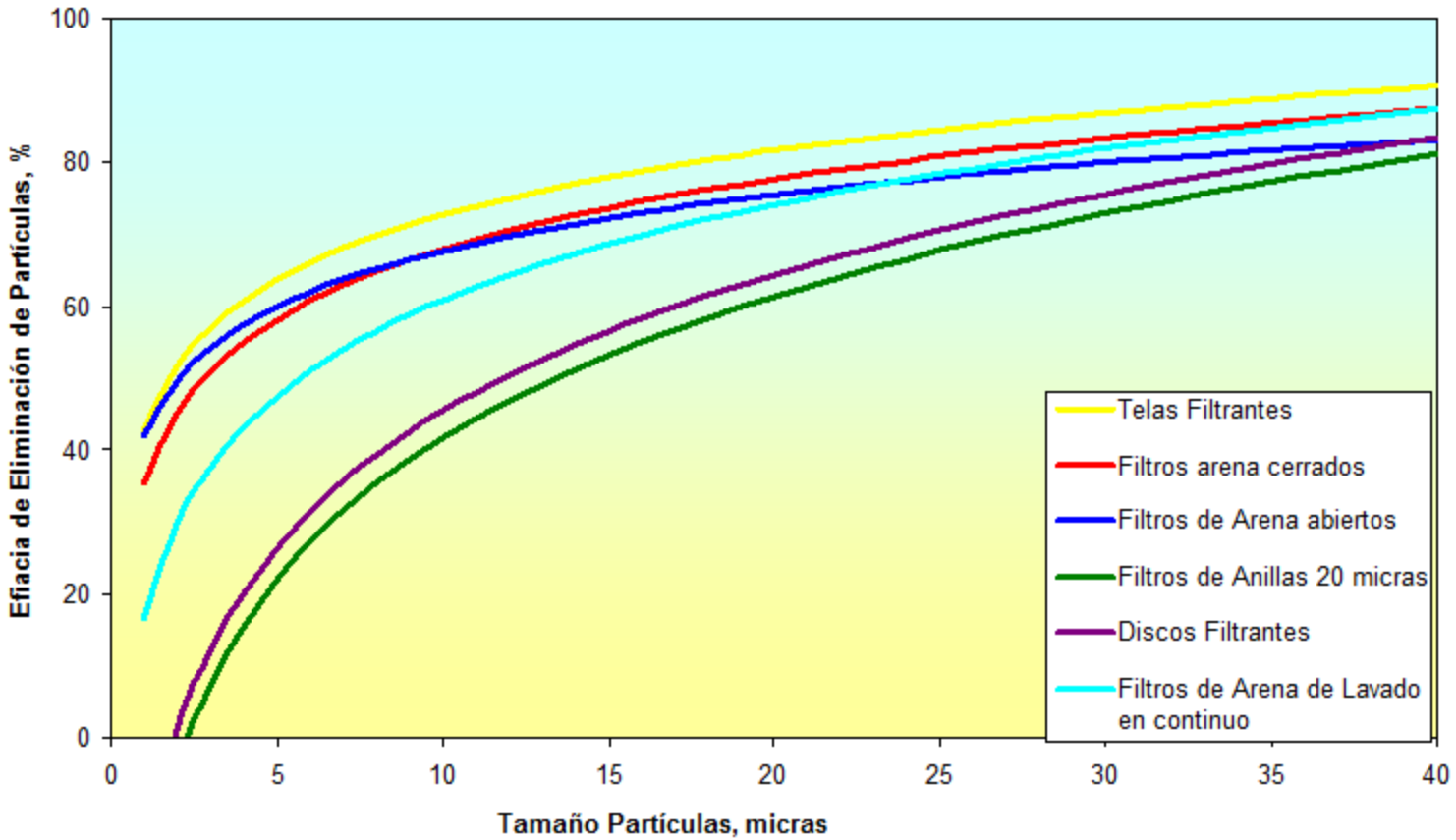
Conventional and advanced tertiary treatments



➤ Particles size study



Conventional and advanced tertiary treatments



Efficiency %

Tamaño Partículas, micras

Particles size, μm

- Cloth Filter
- Closed Sand Filter
- Open Sand Filter

- Ring Filter
- Disc Filter
- Continuous Cleaning Sand Filter

Conventional and advanced tertiary treatments



Disinfection systems

Conventional and advanced tertiary treatments



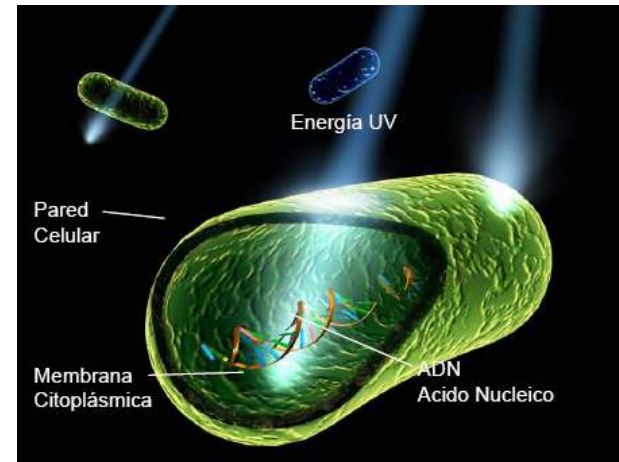
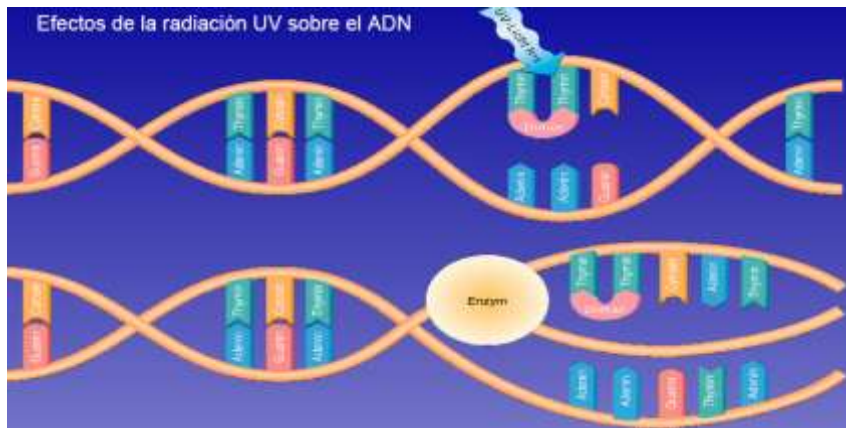
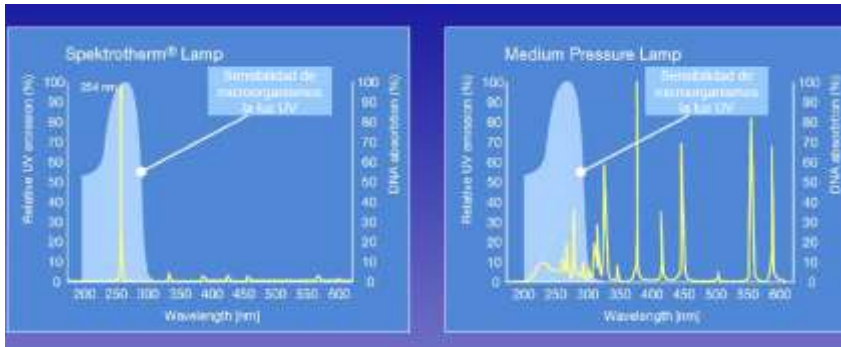
Open channel

Conventional and advanced tertiary treatments



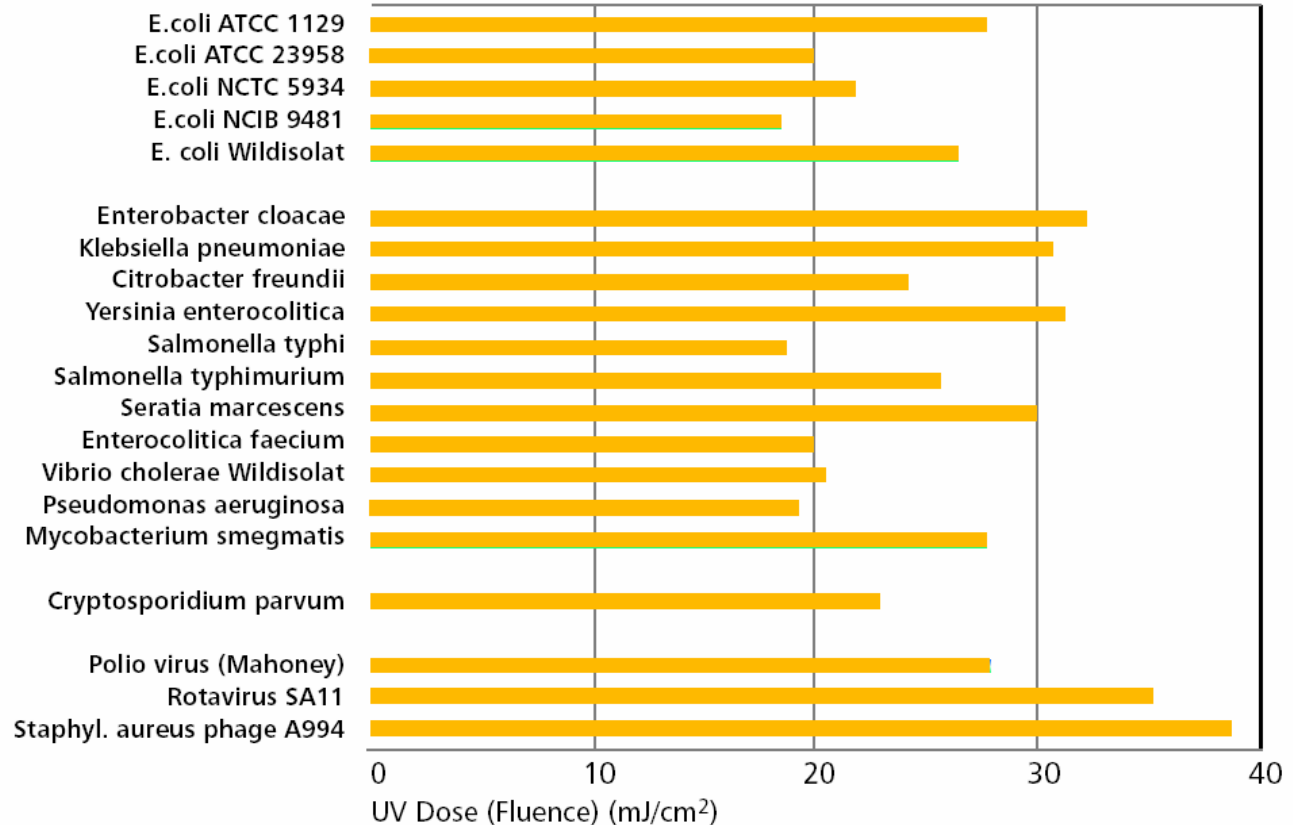
Closed channel

Conventional and advanced tertiary treatments



Germicidal effectiveness of UV radiation

Conventional and advanced tertiary treatments



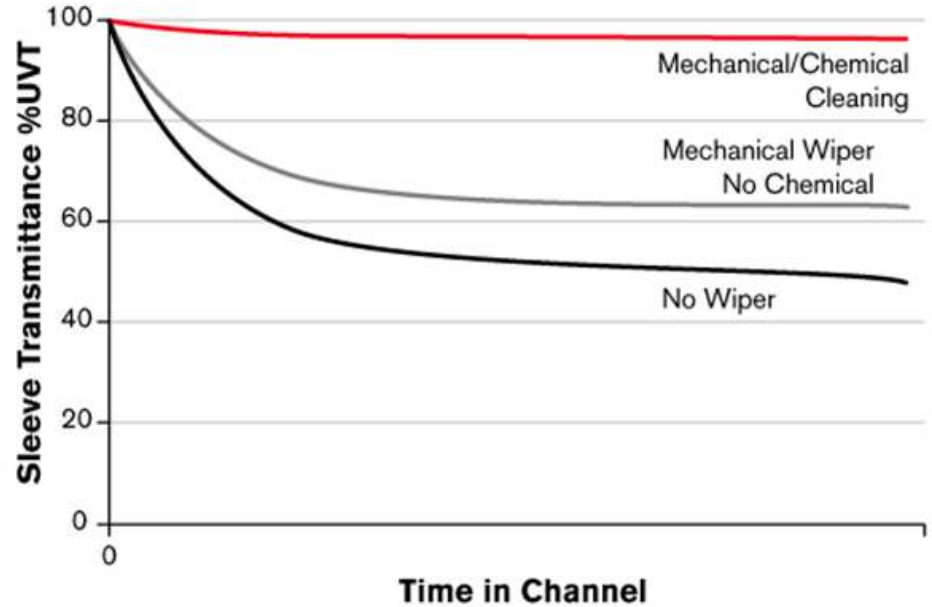
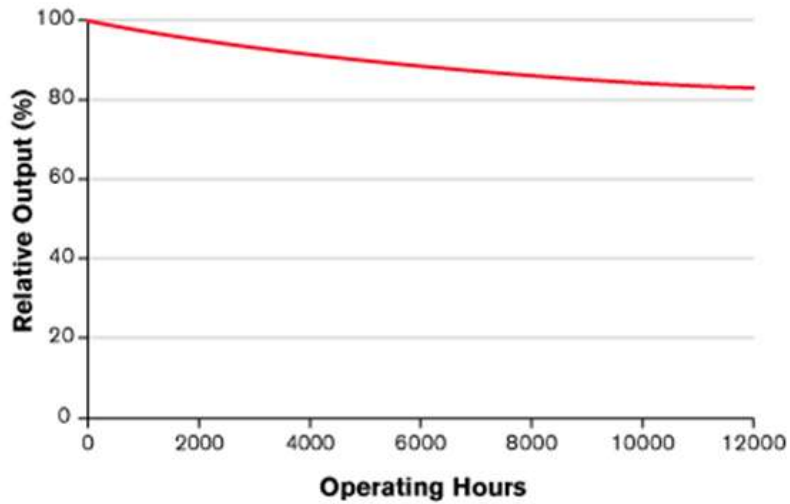
UV dose requirements include effects of photoreactivation

Source: University of Bonn

Effective dosage for different organisms

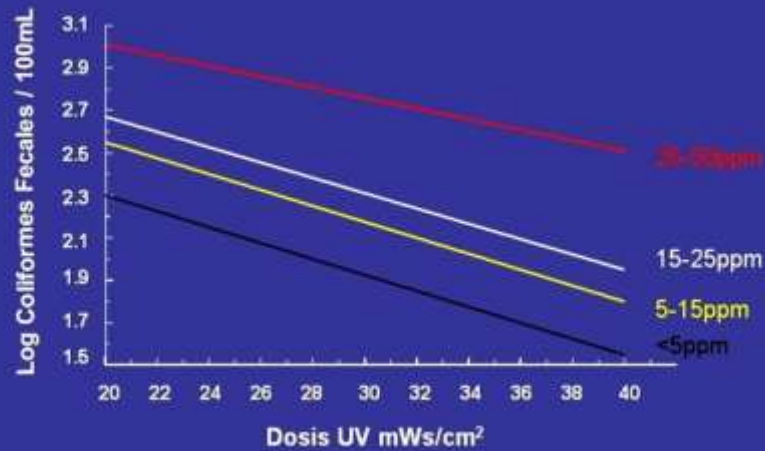
Conventional and advanced tertiary treatments

Lamp Output at Full Power vs. Time

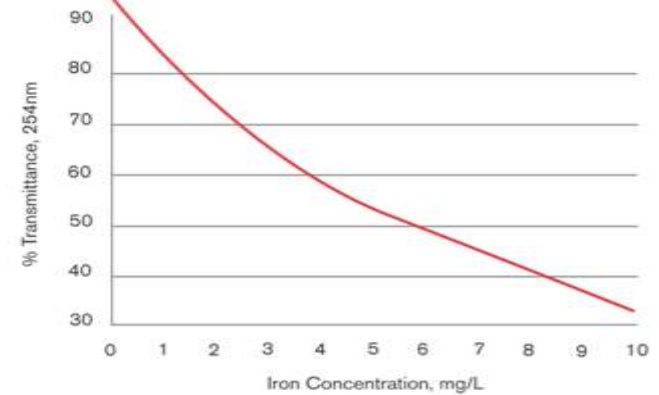


Conventional and advanced tertiary treatments

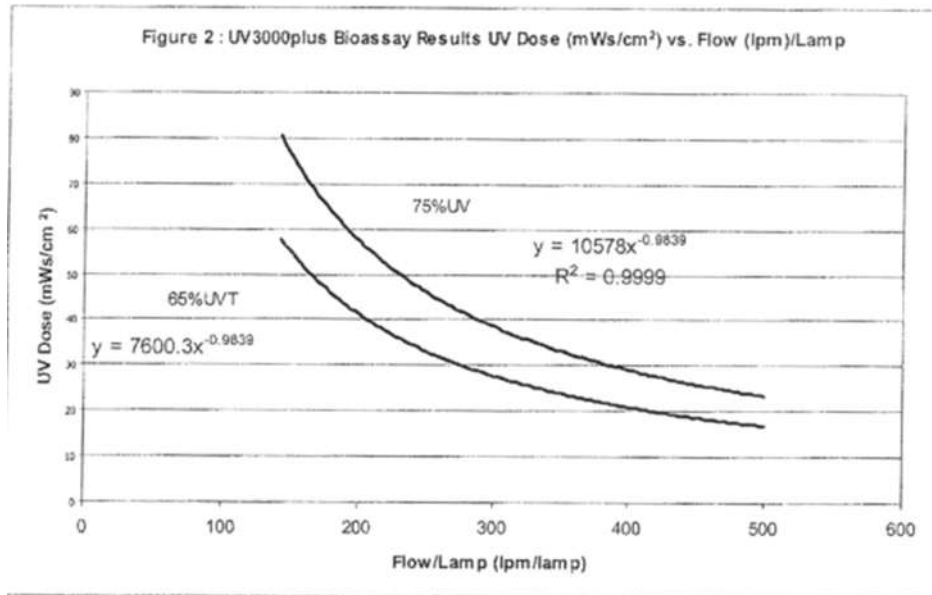
SST vs. Coliformes Fecales Supervivientes



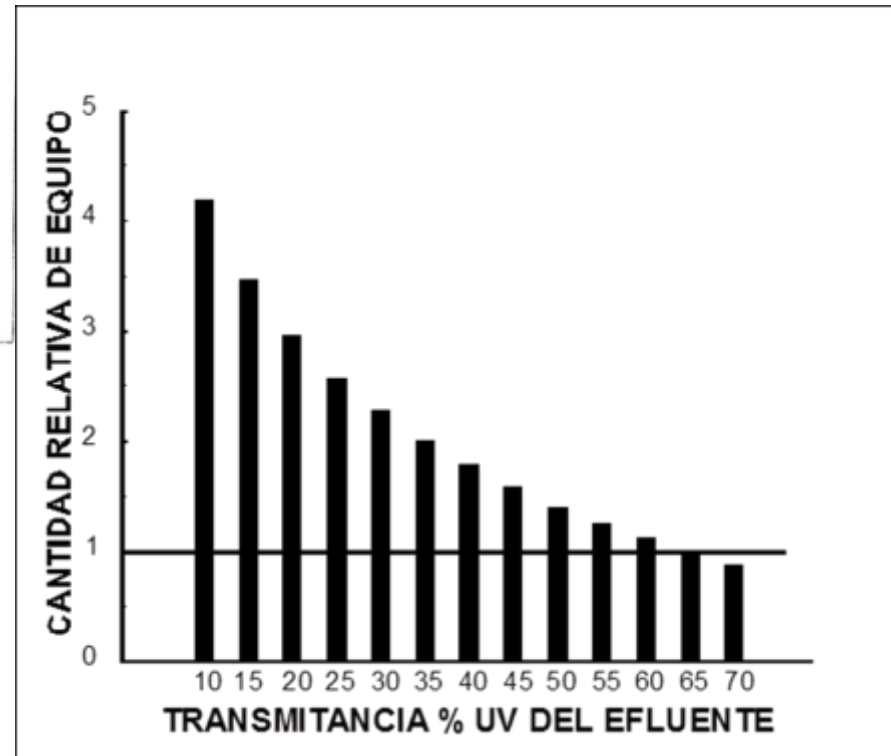
Efecto del Hierro



Conventional and advanced tertiary treatments



Transmittance



Conventional and advanced tertiary treatments

Average, maximum and minimum transmittance for Murcia Region WWTP

<i>EDAR</i>	<i>TRANSMITANCIA</i>		
	<i>PROMEDIO</i> (%)	<i>MÁXIMO</i> (%)	<i>MÍNIMO</i> (%)
<i>Molina Norte</i>	45,1	53,4	31,4
<i>San Pedro</i>	73,0	78,0	69,0
<i>Mazarrón Nueva</i>	67,0	73,0	51,0
<i>Torres de Cotillas</i>	54,8	58,9	51,3
<i>Caravaca de la Cruz</i>	63,0	69,0	58,0
<i>Alhama</i>	57,0	61,0	42,0
<i>Torrepackeco</i>	61,0	70,0	51,0
<i>Mula</i>	41,9	54,7	33,1
<i>Santomera Norte</i>	45,6	50,9	43,3
<i>Lorquí nueva</i>	55,0	60,0	46,2
<i>Jumilla Nueva</i>	59,9	62,0	52,2
<i>Ceutí Nueva</i>	50,0	60,0	30,0
<i>Beniel nueva</i>	60,2	65,1	54,7
<i>Roldán, Lo Ferro y Balsicas</i>	60,0	66,0	50,0
<i>Fuente Álamo</i>	62,0	66,0	55,0
<i>Abanilla</i>	55,6	57,5	53,4
<i>Calasparra MBR</i>	52,8	57,9	48,0
<i>Moratalla</i>	55,0	67,0	42,0
<i>Librilla</i>	59,0	67,0	53,0
<i>MEDIA</i>	56,7	63,0	48,1
mínimo	41,9	50,9	30,0
máximo	73,0	78,0	69,0

Conventional and advanced tertiary treatments

WWTP	Design Flowrate (m3/h)	Design transmittance (%)	Disinfection required	Number of lamps	Real Flowrate (m3/day)	Flow equalition tank	Real transmittance (%)
1	333	65	2,2 TC	80	8.000	Not	55
2	500	65	2,2 TC	120	5.000	Not	59,9
3	600	65	10 FC	64	6.000	Not	46,2
4	208	65	2,2 TC	48	5.000	Not	62
5	1042	65	5 CF	192	25.000	Yes	51,2

Real facilities

Conventional and advanced tertiary treatments

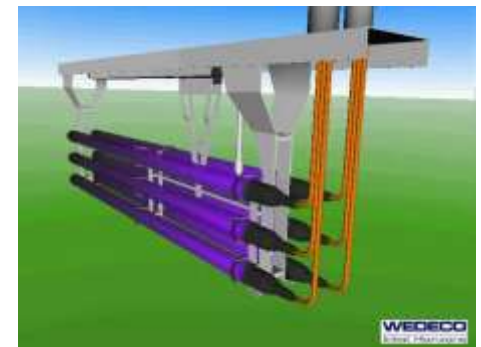
UV: Aspects to consider

Design :

- Real higher flowrates
- Automatic cleaning system
- Real lower transmittance
- No residual effect

Operation :

- Energy intensive
- Difficult dose control when changing lamps
- Non-original lamps

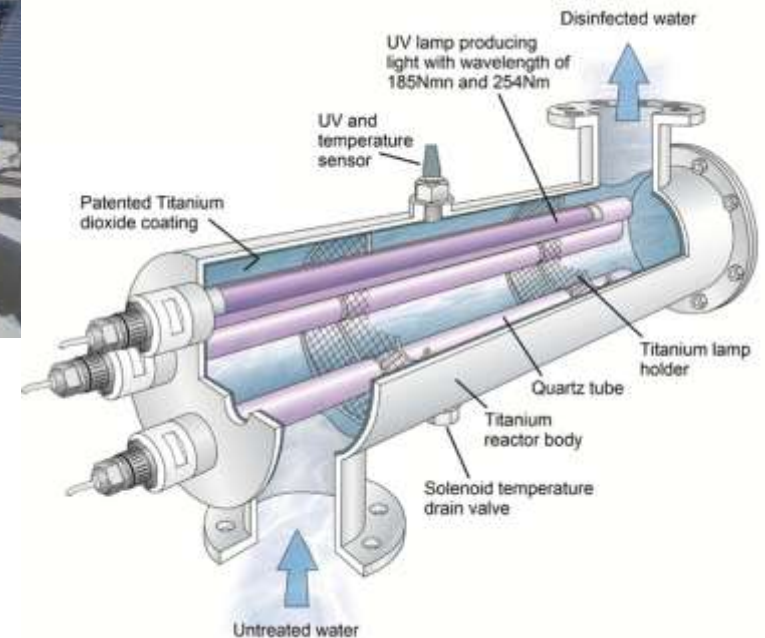


Conventional and advanced tertiary treatments

Item	Average cost (€)	%
Personnel	0,013	20,74
Maintenance	0,013	20,96
Lamps reposicion	0,011	18,47
Reagents	0,002	3,35
Drinkable water	0,00013	0,22
Energy	0,021	33,87
Sludge	0,002	3,07
TOTAL COST	0,06213	

Treatment tertiary : Ph-Ch + Llam-Set + Sand Filter + UV

Conventional and advanced tertiary treatments



Working in other disinfection systems

مع خالص شكري
وامتناني

Thank you
for your attention

Merci pour
votre attention



For additional information please contact:

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