ALL IN ONE SYSTEM NO GRAVEL IS NEEDED

drenotube®

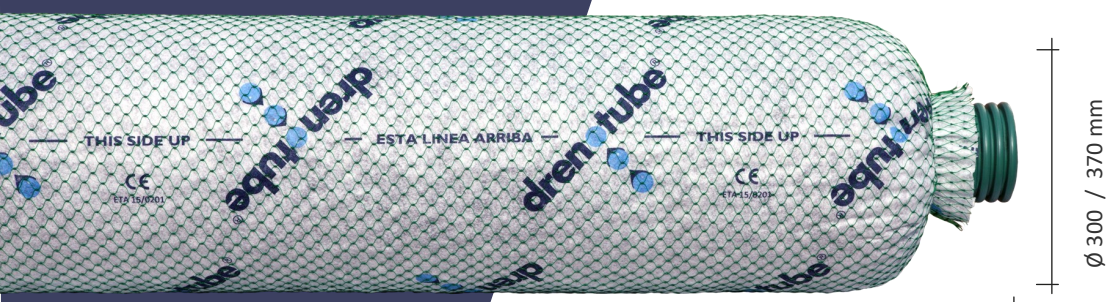
Photo by PAC / Assainissement – Distributor – France

SOIL INFILTRATION

In compliance with Code of Practice CEN/TR 12566-2:2005 (Small Wastewater treatment systems for up to 50 PT)

GEOSYNTHETIC AGGREGATE AND GEOTEXTILE FILTER INCLUDED

TOP VIEW



Ø 300 / 370 mm

L = 3 / 6 m

BOTTOM VIEW

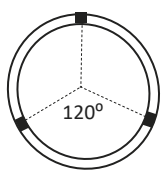
Ø 110 / 160 mm

Opening along the bottom side to avoid clogging and extend service life over 25 years.

BD300/370

IF300 /370

Geosynthetic aggregate



Corrugated pipe 3 holes 15 mm Ø spaced 100mm along the pipe length

drenotube® is a preassembled unit used for underground infiltration applications.

drenotube® preassembled drainage segments consists of a double wall drilled corrugated pipe surrounded by a geosynthetic aggregate enclosed in a high strength polyethylene netting that is clamped to both ends of the pipe.

There is a fabric geotextile filter in between the netting and aggregate. The fabric is used to prevent soil intrusion. Geotextile covers 3/4 of the perimeter section. The uncovered part is installed facing the bottom of the trench to ensure water flow.

- No gravel is needed.
- 100 times lighter than gravel.
- Available in SN4 or SN8 ring stiffness.
- Joined with a fast click fit connector included.

drenotube® Ref	Tube Ø mm	Bundle Ø mm	Ring Sttifness SN	Length m	Water storage capacity litres (void space)
IF300	90/110	300	4 or 8	3 or 6	34
IF370	140/160	370	4 or 8	3 or 6	54
BD300	No pipe	300	4 or 8	3 or 6	32
BD370	No pipe	370	4 or 8	3 or 6	48

BD reference is used to enhance infiltration capacity and void space. It contains geosynthetic particles and geotextile filter but without pipe. Can be only used in combination with IF reference. A SN4 pipe is able to withstand about 60 kPa while a SN8 pipe can hold a máximum pressure of 100 / 120 kPa

CE CERTIFICATE

European Assessment Document EAD 280001-00-0704 ETA 15/0201 EOTAoffice CE

ENVIRONMENTAL AND HEALTH PERFORMANCE

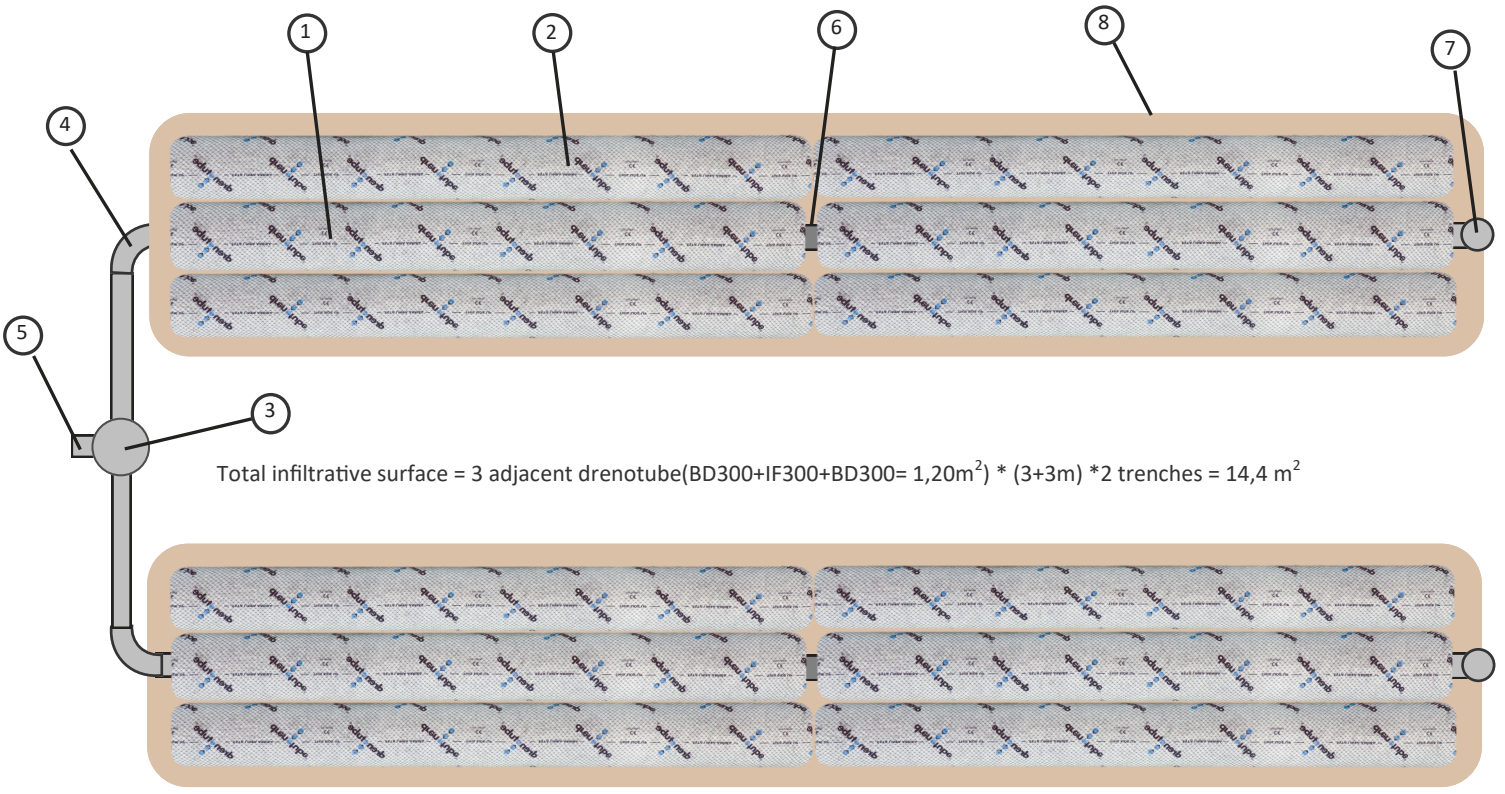
In accordance with standard NF EN 15804 + A1 and its national supplement NF EN 15804 / CN

Verification No: 7-418: 2019

drenotube® FDES is a document that shows the results of a product's life cycle analysis (the extraction of raw materials, transport, implementation and performance to its end of life), as well as health information, used to calculate the environmental and health performance of the drainage networks.

It certifies that **drenotube®** makes a structure more sustainable, with limited impacts on the environment.

Case-C Individual infiltration trenches



Total infiltrative surface = 3 adjacent drenotube(BD300+IF300+BD300= 1,20m^2) * (3+3m) *2 trenches = 14,4 m^2

1 – drenotube® bundle with pipe

2 – drenotube® bundle without pipe

3 – Distribution box

4 – Distribution pipe

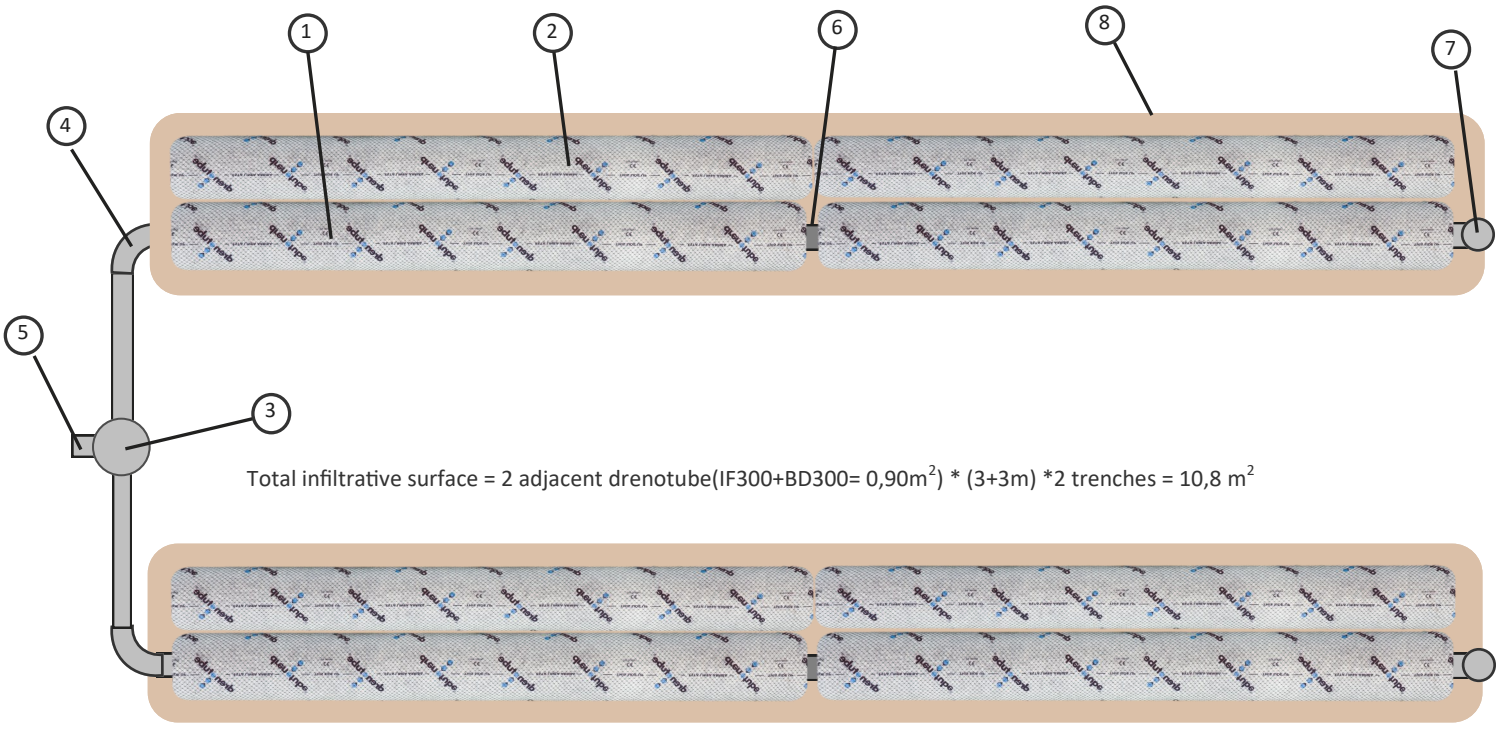
5 – Line from treatment station

6 – Click-fit connector

7 – Aeration pipe

8 – Trench

Case-B Individual infiltration trenches



Total infiltrative surface = 2 adjacent drenotube(IF300+BD300= 0,90m^2) * (3+3m) *2 trenches = 10,8 m^2

ADVANTAGES

PERFORMANCE

- Superior water flow rate and higher storage capacity compared with gravel.
- Test and certificates for the finished product and all components (Compressive strength, creep in compression, ageing, flow capacity, etc.)
- Product has been monitored and evaluated on-site and approved through most US States since 1991 with thousands of installations in use.
- **CE** approval ETA number 15/0201
- FDES LCA (Life Cycle Assestment) NF EN 15804 + A1 and its national supplement NF EN 15804 / CN Verification No: 7-418: 2019

COST EFFECTIVE

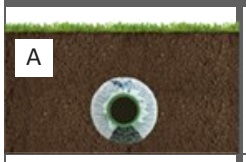
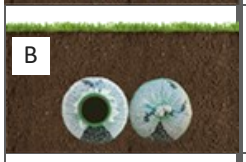
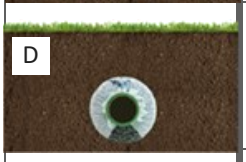
- Saves time, money and avoids trouble-shooting.
- Easier and cheaper transport.
- Easily hand-carried into position reducing time and labor.
- Reduces the volume of excavation.
- No gravel is needed. Easier cleanup at job site.

INSTALLATION

- Quick and easy installation without skilled labour.
- No trucks or heavy equipment are needed to bring the product to the construction site.
- Secure handling. Its lightness entails no labour risk.
- It is clean and fines free.
- Ability to contour along sloped sites and around trees, corners or other obstacles.
- Faster installation. Placement rate 10 meters per minute. Joined with a rapid click fit connection.
- Pre-assembled modules provides entire on-site implementation. Central pipe is surrounded by uniform thickness of aggregate throughout the way. The geotextile filter is perfectly centered.
- Lightweight system is perfect for repairs in tight job sites. About 100 times lighter than gravel. It can be installed quickly with limited site disruption.
- No need of shoring when working in deep trenches. Segments can be joined in the surface and pulled down without entering.

SUSTAINABITILY

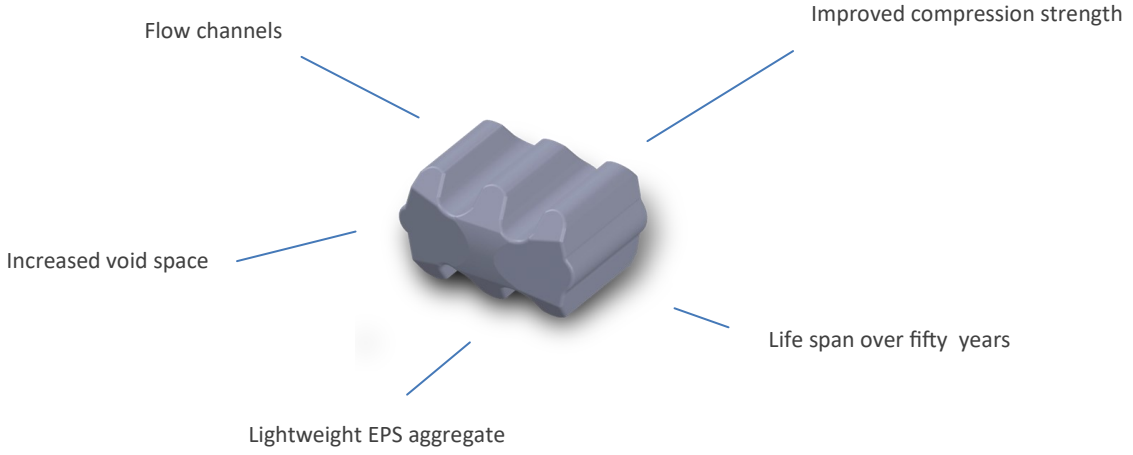
- Manufactured from post-industrial recycled environmentally friendly materials.
- All components are recyclable.
- Avoids environmental impact of aggregate quarrying, preserving the landscape.
- Durable. Expected life span of all components is over 50 years.

Trench configuration	Trench width m	drenotube® Ø m	drenotube® adjacent emplacement	Granular material (sand) thickness below drenotube® m	Infiltrative surface per lineal metre m^2
 A	0,5	0,30	IF300	0,15	0,60
 B	0,6 + 50	0,30	IF300 +BD300	0,15	0,90
 C	0,9 + 50	0,30	BD300+IF300+BD300	0,10	1,20
 D	0,5	0,37	IF370	0,15	0,74
 E	0,74 + 50	0,37	IF370+BD370	0,10	1,11
 F	1,1 + 50	0,37	BD370+IF370+ BD370	0,10	1,48

Geosynthetic EPS Aggregate

The EPS aggregate can remain buried in a wet environment for decades without degradation.

It is a thermoplastic that can be heated, melted and recycled. Energy efficient both in their manufacture and processing. Lightweight material. It is not attacked by fungi, mold and/or mildew.



EPS geosynthetic particles have a particular design to achieve high water flow and void space . Cell size structure suitable for a high compressive strength. It is not brittle at subzero temperatures.

Choose the more convenient infiltration system according to the Code of Practice CEN/TR 12566-2:2005 (Small Wastewater treatment systems for up to 50 PT)

1- Individual trenches (more preferred)

2- Shallow Infiltration Bed (non-cohesive soil)

3- Vertical Infiltration Bed (fissured rock, steep slope)

4- Infiltration Mound (high water table)

Variations in the requirements according to the Infiltration system:

Requirement	Infiltration Trench	Shallow Infiltration Bed	Vertical Infiltration Bed	Infiltration Mound
Total depth m	0,6 to 1	0,6 to 1	1,1 to 1,6	1 to 1,6
Backfill depth m	≥0,2	≥0,2	≥0,1	≥0,2
Granular fill over the infiltration pipe m	0 to 0,1	0 to 0,1	0 to 0,1	0 to 0,1
Distribution layer under infiltration pipe m	0,15 to 0,30	0,15 to 0,30	0,15 to 0,30	0,1 to 0,3
Total distribution layer width m	0,5 to 1,5	≤8	≤5	≤5
Distribution layer length m	≤30	≤30	4 to 30	4 to 30
Ground width between trenches m	≥1	--	--	--
Spacing between pipes	--	0,5 to 1,5	1	0,5 to 1,5
Sand depth on the base of excavation m	--	--	≥0,7	≥0,7
From distribution chamber to base of bed m	--	--	≥0,9	--

A minimum infiltration loading of 150 litres per day and inhabitant must be considered.

drenotube®

Preassembled

drenotube® is fully assembled at the factory and is subject to strict quality controls. Traditional drain fields carried out on site possess major susceptibility of having constructive faults since they depend mostly on the workers' skill degree.

Modular segments

For infiltrative use, **drenotube®** comprises 4 reference series: IF300, IF370 and BD300, BD370 versions (bundles without pipe). Depending on the desired trench or bed configuration BD references can be used to enhance water retention and increase infiltrative surface.

Applications

Complying to the Code of Practice CEN/TR 12566-2:2005 (Small Wastewater treatment systems for up to 50 PT)

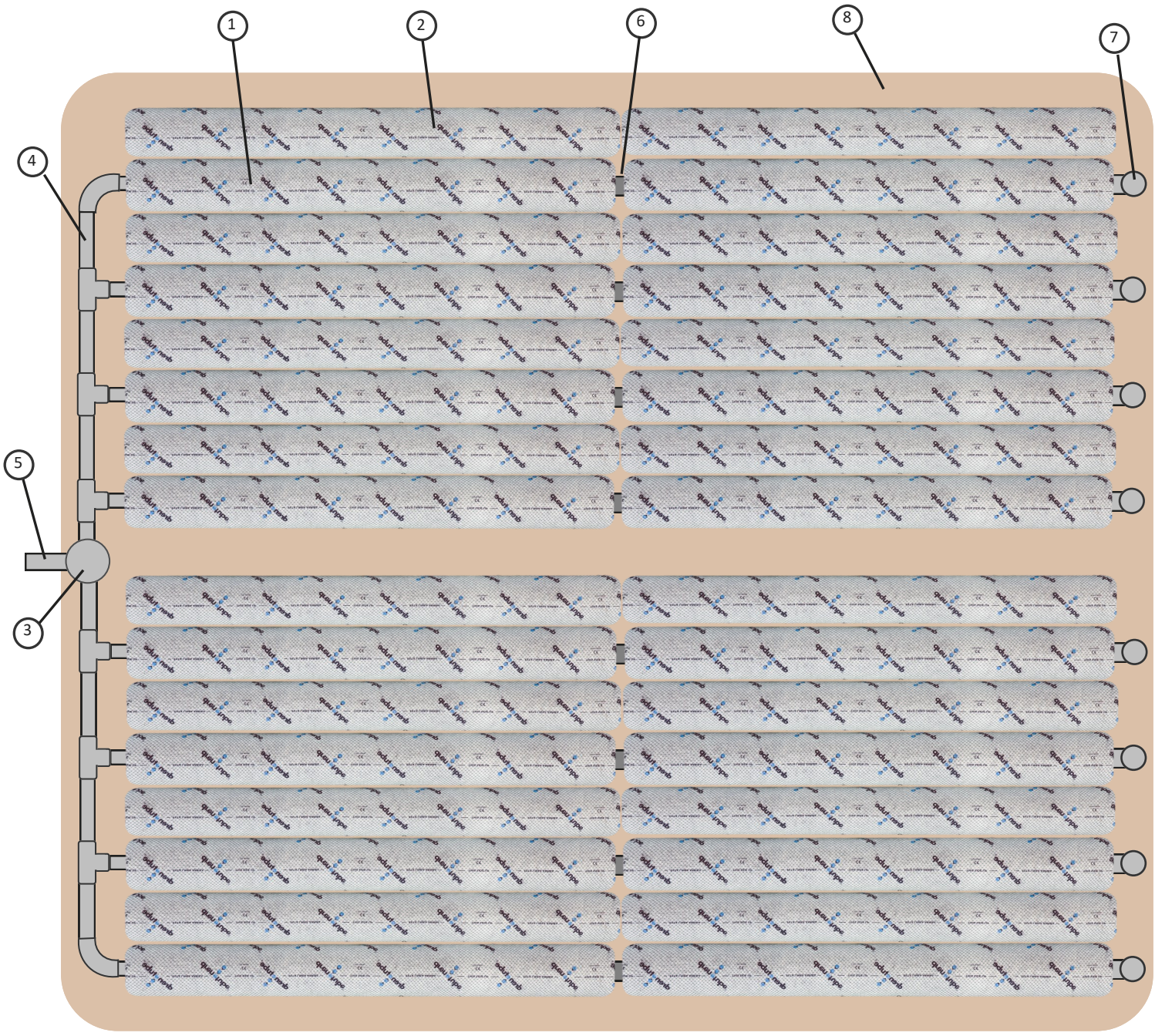
drenotube® can be installed in all kind of infiltration systems: 1-Infiltration trenches 2-Shallow infiltration beds 3-Vertical infiltration beds 4– Infiltration mounds.

drenotube® shallow infiltration bed

drenotube® complies with the performance criteria of CEN/TR 12566 : 2005

- Provides a distribution layer composed of granular fill material.
- Perforations ensure that granular material can not enter the pipe and effluent can flow without clogging.
- Geosynthetic aggregate (gravel substitute) in the range of 8 to 32 mm providing a minimum 30% void volume during entire life of the system.
- Geotextile on top of the gravel substitute media as a barrier to prevent contamination by backfill.
- Drilled infiltration pipe with smooth inner surface
- Materials are non-decaying and non-deteriorating and do not leach chemicals when exposed to sewage and the subsurface soil environment
- Provides suitable effluent distribution to the infiltrative surface at the soil interface; and
- Maintains the integrity of the trench or bed. The materials used, withstand the physical forces of the soil sidewalls, soil backfill and the weight of equipment used in backfilling.

Illustration of individual infiltration bed



1 – drenotube® bundle with pipe

2 – drenotube® bundle without pipe

3 – Distribution box

4 – Distibution pipe

5 – Line from treatment station

6 – Click-fit connector

7 – Aeration pipe

8 – Trench

It is recomended to provide a sand layer bed of 10 cm thickness below denotube® to improve the distribution of the effluent.

How to calculate lineal metres of **drenotube®** needed per a certain number of inhabitants

QD= Total loading to be infiltrated (litres) per day

PT= Number of inhabitants / population equivalents

LPT= Infiltration loading per day and inhabitant = 150 litres

LTAR= LongTerm Acceptance Rate

A= Total infiltrative area needed (m^2)

M= Total metres of drenotube configuration needed

IT= Infiltration surface per lineal metre of the choosen configuration

1 Calculate QD (Total loading to be infiltrated (litres) per day) $$QD = PT * LPT$$

2 Calculate A (Total infiltrative área for a given number of PT) $$A = \frac{QD}{LTAR}$$

Find **Long Term Acceptance Rate LTAR** (using double ring infiltrometer test and according to table below). It is the amount of pre-treated effluent which the system can infiltrate during its lifetime without water logging or clogging (l/m2/d)

SOIL TYPE	LTAR l/m^2/d Litres per day per square metre	**drenotube®** litres per day per lineal metre	
		IF300 xxxxxxx	IF370xxxxxxx
Medium and coarse gravel	Not permitted		
Fine gravel+coarse sand mixture	20 to 50	12 to 30	15 to 37
Fine or silty sand	15 to 30	9 to 18	11 to 22
Silt or sandy silt	10 to 15	6 to 9	7 to 11
Silty clay loam	10	6	7
Silty clay or clay	Not possible		

3 Calculate M (Metres of drenotube® configuration – trench needed) $$M = \frac{A}{IT}$$

Depending on the choosen configuration, drenotube® metres can be M 2xM or 3 x M

Find "IT" (infiltration surface per lineal metre of drenotube® configuration) by choosing the drenotube® pipe diameter IF300 or IF370 and also distribution of pipes inside the trench A, B or C

IT-A IF300=0,60
IT-D IF370=0,74

IT-B IF300=0,90
IT-E IF370=1,11

IT-C IF300=1,20
IT-F IF370=1,48

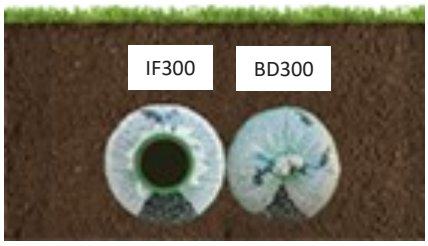
drenotube® infiltration trench example for a single house 8 Inhabitants (PT)

1. Calculate QD (Total loading to be infiltrated (litres) per day) QD= PT * LPT = 8 * 150 = 1200 litres/day

2. Calculate A (Total infiltrative area for a given number of PT) A= QD/LTAR = 1200 / 15 = 80 m^2

After measuring the soil permeability with the ring infiltrometer it was found a silty soil with LTAR of 15 litres/m^2/day

3. Calculate M (Metres of drenotube® configuration – trench needed)



Infiltrative surface = 0,90 m2/lineal metre

Configuration IT-B

Trench configuration IT-B M = A / IT = 80 / 0,90 = 89 lineal metres

It was choosen a trench configuration with 2 adjacent bundles: one conveying pipe Ref IF300 next to a only bundle Ref BD300 used to enhance void space and increase infiltrative surface

15 **drenotube®** Ref. IF300SN04ST6 + 15 **drenotube®** Ref. BD3000000ST6

drenotube® length = 6 m x 15 = 90 metres SN=Ring stiftness = 4

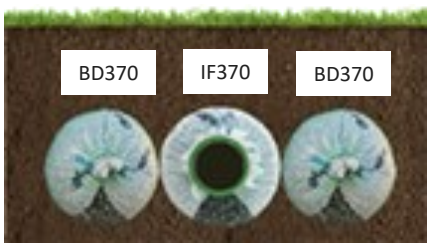
drenotube® infiltration trench example for a single house 8 Inhabitants (PT)

1. Calculate QD (Total loading to be infiltrated (litres) per day) QD= PT * LPT = 8 * 150 = 1200 litres/day

2. Calculate A (Total infiltrative area for a given number of PT) A= QD/LTAR = 1200 / 25 = 48 m^2

After measuring the soil permeability with the ring infiltrometer it was found a silty soil with LTAR of 25 litres/m^2/day

3. Calculate M (Metres of drenotube® configuration – trench needed)



Infiltrative surface = 1,48 m2/lineal metre

Trench configuration IT-B M = A / IT = 48 / 1,48 = 32,4 lineal metres

It was choosen a trench configuration with 3 adjacent bundles: one conveying pipe Ref IF300 and a only bundle Ref BD300at each side used to enhance void space and increase infiltrative surface

6 **drenotube®** Ref. IF370SN04ST6 + 12 **drenotube®** Ref. BD3700000ST6

drenotube® length = 6 m x 6 = 36 metres SN=Ring stiftness = 4

Covering a shallow infiltration bed

drenotube® Infiltration trenches

Gravel drawbacks in drainfields:

- The detrimental effect of gravel impacting and compressing the infiltrative surface when dumped into the drainfield trench from the front-end loader of a backhoe, which may lower the infiltrative capacity of the soil.
- Improperly washed gravel can contribute fines and other material that can plug voids in the infiltrative surface and reduce hydraulic capability. Gravel that is embedded into clay or fine soils during placement can have the same effect. Use of drenotube avoids this problem.
- The damaging effect that the transportation of gravel across the sites can have on lawns, flowerbeds, shrubs, etc. and the reduced air transport to the infiltrative surface from compacted soils, all due to the weight of the material and the size of the heavy equipment needed to effectively move it from the stock pile to the drainfield area.

The disposal area shall be located according to the following minimum criteria:

- Seasonal highest groundwater table at 1 metre from surface.
- No part of the soil disposal area shall be closer than 4 m to the nearest point of the nearest habitable dwelling.
- No part of the disposal area shall be within 4 m of the nearest road boundary or ditch nor within 2 m of the boundary of the adjoining site. Disposal areas in the vicinity of small water courses shall be at least 10 m from the highest level. Larger water courses will need special considerations.
- The growth of any type of tree or plant which develops an extensive root system is limited to a minimum distance of 3 m from the infiltration system. This restriction also applies to the cultivation of crops.
- Water supply pipes or underground services other than those required by the infiltration system itself shall not be located within the disposal area.
- Access roads, driveways or paved areas shall not be located within the disposal area.

Depth and pressure figures applied on drenotube®

Depth from **drenotube®** to surface m	Total pressure acting on **drenotube®** kN/m^2	Total pressure in a saturated soil kN/m®
0,5	9	11
1	19	21
1,5	28	30

It is considered a parallel trench with a backfill soil density of 1900 kg/m^3 Trench width is drenotube Ø + 20 / 60 mm. To find a more accurate results will depend on the soil density, porosity, water content, nature of different layers and cohesive forces amongst others.

Corrugated pipe	Standard	Unit	Value
Outer diameter	UNE EN 61386-1	mm	110
Inner diameter	UNE EN 61386-2-4	mm	SN04 : 93 SN08 : 91
Ring stiffness	UNE EN ISO 9969	kN/m^2	SN04 : 4 SN08 : 8
Perforation type		º	360
Slits surface		cm^2/m	50 (±10)
Polymer	UNE 53994 :2011		Polyethylene
Geosynthetic aggregate	**Standard**	**Unit**	**Value**
Bulk density	UNE 92120-2:1998	kg/m^3	10
Specific weight	UNE 83134	kg/m^3	20
Void space		%	50
Specific surface		m^2/m^3	230
Particle number		$units/m^3$	~115.000
Water absorbtion 7 days	UNE EN 12087:1997	%	2,0
Water absorbtion 21 days	UNE EN 12087:1997	%	2,2
Particle size distribution	UNE EN 933-1	% pass	<8 mm: 0 <20 mm: 73 <25 mm: 100
Working temperature	-	ºC	-20 a +65
Color	-	-	Graphite
Geotextile filter	**Standard**	**Unit**	**Value**
Polymer	-	-	Polypropylene
Bonding technique	-	-	Needle punched
Mass per unit area	UNE EN ISO 9864	g/m^2	100
Thickness 2 kPa	UNE EN ISO 9863-1	mm	0,7
Tensile strength MD/CMD	UNE EN ISO 10319	kN/m	8,0/8,0
Elongation at max. load MD/CMD	UNE EN ISO 10319	%	90/80
Static puncture resistance (CBR)	UNE EN ISO 12236	N	1300
Cone drop test	UNE EN ISO 13433	mm	28
Water permeability	UNE EN ISO 11058	$m^3/s/m^2$	0,120
In plane capacity @ 20 kPa	UNE EN ISO 12958	$m^3/s/m$	1x10-6
Opening size O90	UNE EN ISO 12956	µm	80
UV protection			Yes
Net	**Unit**	**Value**	
Polymer	-	Polyethylene	
Weight per unit	g/m	67	
Semiperimeter	cm	51	
Net type	-	Oriented tubular	
Drenotube ®	**Unit**	**Value**	
Length	m	3 or 6	
Weight	g/m	SN04 ~ 1300 SN08 ~ 1592	
Draining surface	cm^2/m	SN04 : 51 SN08 : 50	
Bundle diameter	mm	300	
Maximum installation depth	m	SN04 : 3 SN08 : 5	
Minimum installation depth	m	0,40	

Corrugated pipe	Standard	Unit	Value
Outer diameter	UNE EN 61386-1	mm	160
Inner diameter	UNE EN 61386-2-4	mm	SN04 : 140 SN08 : 136
Ring stiffness	UNE EN ISO 9969	kN/m^2	SN04 : 4 SN08 : 8
Perforation type		º	360
Slits surface		cm²/m	85 (±10)
Polymer	UNE 53994 :2011		Polyethylene
Geosynthetic aggregate	**Standard**	**Unit**	**Value**
Bulk density	UNE 92120-2:1998	kg/m^3	10
Specific weight	UNE 83134	kg/m^3	20
Void space		%	50
Specific surface		m^2/m^3	230
Particle number		units/m^3	~115.000
Water absorbtion 7 days	UNE EN 12087:1997	%	2,0
Water absorbtion 21 days	UNE EN 12087:1997	%	2,2
Particle size distribution	UNE EN 933-1	% pass	<8 mm: 0 <20 mm: 73 <25 mm: 100
Working temperature	-	ºC	-20 a +65
Color	-	-	Graphite
Geotextile filter	**Standard**	**Unit**	**Value**
Polymer	-	-	Polypropylene
Bonding technique	-	-	Needle punched
Mass per unit area	UNE EN ISO 9864	g/m^2	100
Thickness 2 kPa	UNE EN ISO 9863-1	mm	0,7
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Cone drop test	UNE EN ISO 13433	mm	28
Water permeability	UNE EN ISO 11058	m^3/s/m^2	0,120
In plane capacity @ 20 kPa	UNE EN ISO 12958	m^3/s/m	1x10-6
Opening size O90	UNE EN ISO 12956	µm	80
UV protection			Yes
Net	**Unit**	**Value**	
Polymer	-	Polyethylene	
Weight per unit	g/m	76	
Semiperimeter	cm	63	
Net type	-	Tubulaire orientée	
Drenotube ®	**Unit**	**Value**	
Length	m	3 or 6	
Weight	g/m	SN04 ~ 2150 SN08 ~ 2482	
Draining surface	cm^2/m	SN04 : 51 SN08 : 50	
Bundle diameter	mm	370	
Maximum installation depth	m	SN04 : 3 SN08 : 5	
Minimum installation depth	m	0,40	

drenotube®

P R E A S S E M B L E D S O I L I N F I L T R A T I O N S Y S T E M S

Trench | Connect | Place | Backfill

National regulations may specify different arrangements between the products described and shall prevail over CEN/TR 12566

EASY TO INSTALL

COST EFFECTIVE

EFFICIENCY

ECO FRIENDLY

FUMOSO INDUSTRIAL S.A. LIMITED WARRANTY

drenotube® when installed and operated in a drainage system in accordance with Fumoso Industrial S.A. instructions, is warranted to the original purchaser "Holder" against defective materials and workmanship. Fumoso liability specifically excludes the cost of removal and/or installation of the drenotube® "Units"

The limited warranty is exclusive. There are no other warranties with respect to the Units.

This Limited Warranty shall be void if any part of the drenotube® system is manipulated by anyone other than Fumoso. The Limited Warranty does not extend to incidental, consequential, special or indirect damages. Fumoso shall not be liable for penalties or liquidated damages, including loss of production and profits, labor and materials, overhead costs, or other losses or expenses incurred by the Holder or any third party. Specifically excluded from Limited Warranty coverage are damage to the Units due to ordinary wear and tear, alteration, accident, misuse, abuse or neglect of the Units; the Units being subjected to vehicle traffic or other conditions which are not permitted by the installation instructions; failure to maintain the minimum ground covers set forth in the installation instructions; the placement of improper materials into the system containing the Units; failure of the Units due to improper siting or improper sizing or improper operation; or any other event not caused by Fumoso. This Limited Warranty shall be void if the Holder fails to comply with all of the terms set forth in this Limited Warranty. Further, in no event shall Fumoso be responsible for any loss or damage to the Holder, the Units, or any third party resulting from installation or shipment, or from any product liability claims of Holder or any third party. For this Limited Warranty to apply, the Units must be installed in accordance with all site conditions required by the local authorities and normatives and all other applicable laws and Fumoso Industrial S.A. installation instructions.

No representative of Fumoso Industrial S.A. has the authority to change or extend this Limited Warranty. No warranty applies to any party other than the original Holder.

CE

ETA 15/0201

ITeC EOTAoffice

FDES VÉRIFIÉE inies

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