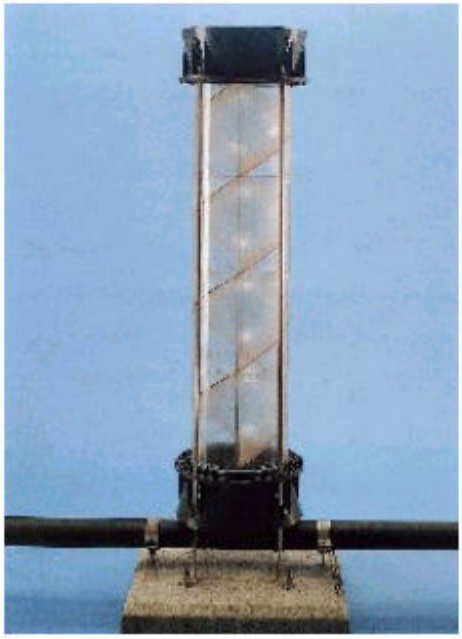
CATALOGUE : **JetHelix®**

Product : **Aerobic Static Diffuser - High Yield**

Technical Description : Aerobic Air Bubbles Static Diffuser for the Aerobic Treatment of Waste Waters

Commercial Category : **Diffuser for Air or Gas**



Applications :
1 **Aerobic Treatment**
2 **Sludge Treatment** & **Bio-Gas Production**
3 **Fluidodynamic Barriers**

Sectors :
> **Water & Ecology**
> **Water Treatment : Civil and Industrial Wastes**
> **Pollution Control**
> **Pollution Prevention**

Key-Words :

1 Oxygenation Efficiency
2 Air Bubbles
3 Interfacial Contact
4 Liquid Mixing & Pumping
5 High Resistence
6 Biological Treatment

Prepared 6.03.2008
Revised 24.10.2009

" Made in Process "

Made in Italy

Head Office : 3 , Via XXV Aprile – 22070 Fenegrò – Como – ITALY – E.U.
Phone : +39–031–895.374 Partita IVA/C.F. Reg. Imp.MI 13395210159 URL : www.pe-process.it
Fax : +39–031–3524.907 C.C.I.A.A. n. 1647291 Trib. Milano n. 213317 - Cap. soc. i.v. € 99.000,00. E-mail : process@pe-process.it

JetHelix® : Aerobic Static Diffusers – High

1) The JetHelix® : the best approach to AERATION

The **JetHelix®** is the best approach to AERATION and is characterized by the following factors:

- the presence of air bubbles
- a further upgrading in the oxygen transfer , as reported by the equipment's oxygen transfer curves .

***JetHelix®*: top view**

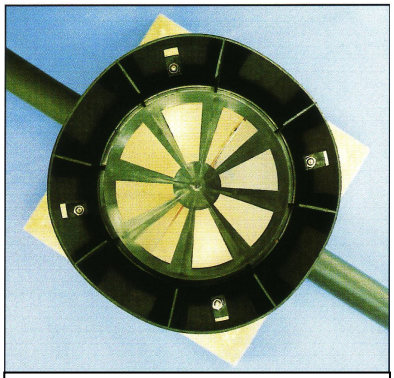


FIG 1 : Jet-Helix – vista dall'alto

JetHelix® : The Story

Thanks to the expertise and knowledge acquired in the utilization of **Helixor** for the engineering and realization of waste water treatment plants, during the 80's **Dr Petrillo** started to think-up and develop a new equipment with the following properties :

- oxygen transfer , higher than the **Helixor**
- high mechanical resistance
- high efficiency
- long working life
- resistance to chemical

The result of these R&D , calculations and design has been the **invention by Dr Petrillo** of the **JetHelix®** , that is the up-grading of the **Helixor** .

Patents and trade-marks have been deposited.

- **About JetHelix®**

The **JetHelix®** is the static diffuser with air bubbles .

In the water treatment the scope of the **JetHelix®** is to insufflate the air required for the treatment of the waste water, according to :

- process parameters;
- process conditions;
- effluent requirement .

The use of the **JetHelix®** guarantees:

- oxygen transfer
- mixing of the bacins
- high pumping capacity

AS A CONSEQUENCE

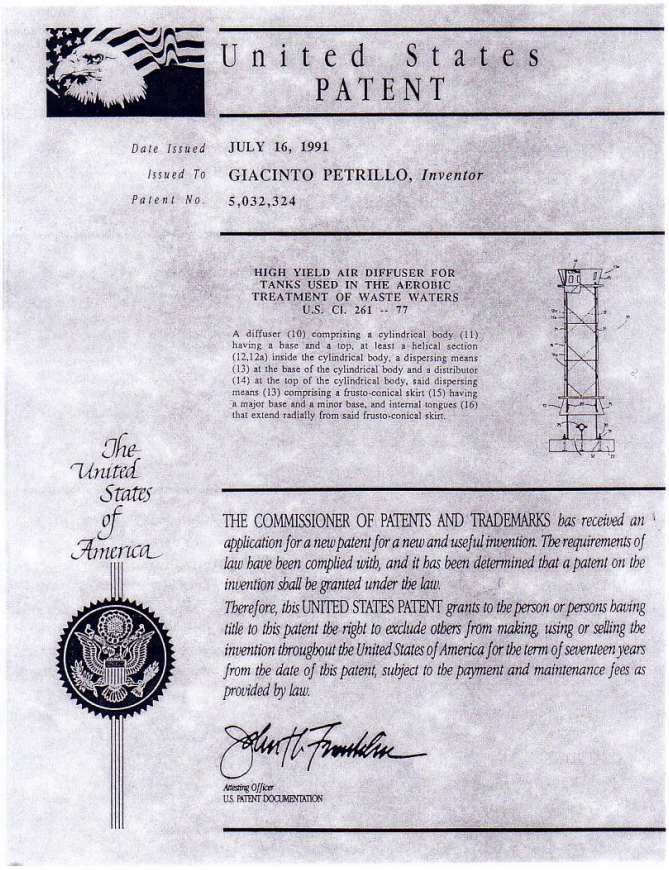
The **JetHelix®** is the static diffuser to be largerly utilised for :

- biological treatment

when
- high yield in oxygen transfer ,
- oxygenation efficiency
- high resistence

are required.

- **Jet-Helix : U.S. Patent**



United States
PATENT

Date Issued JULY 16, 1991
Issued To GIACINTO PETRILLO, *Inventor*
Patent No. 5,032,324

HIGH YIELD AIR DIFFUSER FOR TANKS USED IN THE AEROBIC TREATMENT OF WASTE WATERS
U.S. Cl. 261 -- 77

A diffuser (10) comprising a cylindrical body (11) having a base and a top, at least a helical section (12,12a) inside the cylindrical body, a dispersing means (13) at the base of the cylindrical body and a distributor (14) at the top of the cylindrical body, said dispersing means (13) comprising a frusto-conical skirt (15) having a major base and a minor base, and internal tongues (16) that extend radially from said frusto-conical skirt.

The United States of America

THE COMMISSIONER OF PATENTS AND TRADEMARKS *has received an application for a new patent for a new and useful invention. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.*
Therefore, this UNITED STATES PATENT *grants to the person or persons having title to this patent the right to exclude others from making, using or selling the invention throughout the United States of America for the term of seventeen years from the date of this patent, subject to the payment and maintenance fees as provided by law.*

Attesting Officer
U.S. PATENT DOCUMENTATION

Phone : +39–031–895.374 Partita IVA/C.F. Reg. Imp.MI 13395210159 URL : www.pe-process.it
Fax : +39–031–3524.907 C.C.I.A.A. n. 1647291 Trib. Milano n. 213317 - Cap. soc. i.v. € 99.000,00. E-mail : process@pe-process.it

2) A WIDE RANGE of APPLICATIONS

Thanks to its properties and flexibility of utilization , the **JetHelix®** system has been successfully applied with :

- different applications
- civil and agro-industrial wastes
- different industrial effluents discharged by many types of Industries

APPLICATION :

- **Domestic :**
  Municipalities, hospitals, resort facilities, hotels and the like.
- **Industrial :**
  galvanic, automotive, mechanical, electronic and electric, photoengraving, photography, chemical, pharmaceutical, iron metallurgy, petrochemical, textile, tannery, wood processing , paper mills, ceramic, rubber, rubber thread .
- **Oil & Gas**
- **Breeding facilities, foodstuff & agricultural processing industries:** swine, minks and cattle breeding, slaughterhouses, production of salami, olive-oil, wine, spirits, beverages, ice-cream, frozen and tinned foodstuffs ... .
- **Mixtures** of **Industrial** & **Domestic Wastes.**

SUCCESSFULLY APPLIED for :

- **Oxygenation** of natural and man-made impoundments.
- **Oil** and **metal recovery** from wastes.
- **Recovery** of **Proteins** (olive oil and fat industries).
- **Spring-waters conditionings**.
- **Sludge dewatering**.
- **Re-utilization of Bio-gas**, developed during anaerobic fermentation.
- **Ice-prevention systems**
- **Pneumatic Barriers**.
- **Fluido-dynamic Barriers**.

FIG 2 : JetHelix® in operation : Waste water treatment plant, Indonesia

Phone : +39–031–895.374 Partita IVA/C.F. Reg. Imp.MI 13395210159 URL : www.pe-process.it
Fax : +39–031–3524.907 C.C.I.A.A. n. 1647291 Trib. Milano n. 213317 - Cap. soc. i.v. € 99.000,00. E-mail : process@pe-process.it

3) The JetHelix®: biological treatment for Domestic and Industrial wastes

The **JetHelix®** exploits **three** basic engineering **principles** for the **oxygen transfer:**

- larger **Interfacial Contact Area** provided by small air bubbles .
- **Prolonged Interfacial Contact**, provided by the helix component, causing the mixture of air and water to travel more than twice the distance of the Helixor length.
- **Tubulent Flow** for a maximum oxygen transfer provided by spiral velocities in excess of 4 ft./sec .

Furthermore the submerged Jet-Helix havo no moving parts and are **completely maintenance free**

The total absence of moving components - other than air and water – within the **JetHelix®** and the high velocities across the orifices guarantee :

1) a completely **mainteinance-free** operation

2) a **trouble-free** operation

in all the plants and installations , where the **JetHelix®** is applied .

The **JetHelix®**, especially developed for waste-water treatment, represents the best combination for shifting the maximum volume of water from the bottom to the surface for a given power input and aerating that water throughout the created flow. .

Three element *JetHelix®*

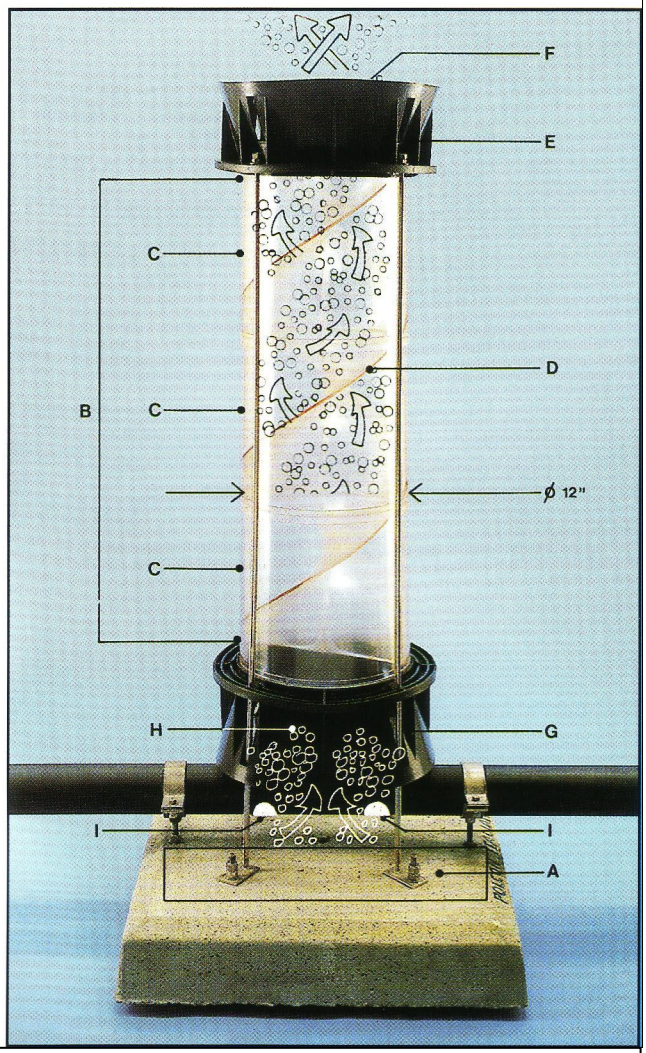


FIG 3 : Jet-Helix – a tre elementi

The **JetHelix®** is anchored (A) in a vertical position on the bottom of the basin or tank . The **JetHelix®**, as shown in Fig. 1 , is a **12 inch diameter** PP (polypropylene) tube (B) , composed of several elemente (C , i.e. the HelieR structured packing) , and incorporating a monolithic helix component (D) of designed pitch , which devides the tube, longitudinally , into two separe sections .

A cone-shaped flanged distributor with inside baffles at the top (E) , a star-flow distributor at the top (F) and a cone-shaped flanged distributor with inside baffles at the bottom (sparger , G) are the **new devices** to maximize the oxygen transfer .

At the bottom opening of the tube, **compressed air** in the form of **small bubbles** (H) is introduced through two orifices (I) , one on each side of the helix component .

The air rising inside the vertically aligned **Jet-Helix** causes the water to flow. This mixture of water and air follows a tortous spiral passage which prolongs the interfacial contact between small air bubbles and the liquid .

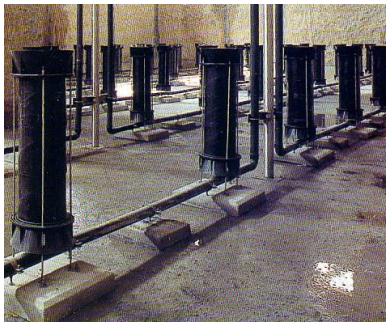
As the flow is very turbulent, **maximum oxygen transfer** is ensured .

The highest percentage of oxygenation of the liquid takes place within the **JetHelix®**.
The stream of liquid and air causes, as it leaves the tube, a **free turbulent jet** , which entrains additional quantities of liquid in its movement towards the surface .

Within the bubbles rising to the surface in the induced vortex at the turbulent surface boil and at the sorrounding areas above the **JetHelix®**, maximum oxygen transfer is achieved as the water spreads radially away from the upwelling region .

Phone : +39–031–895.374 Partita IVA/C.F. Reg. Imp.MI 13395210159 URL : www.pe-process.it
Fax : +39–031–3524.907 C.C.I.A.A. n. 1647291 Trib. Milano n. 213317 - Cap. soc. i.v. € 99.000,00. E-mail : process@pe-process.it

4) JetHelix®Static Diffuser: equipment sheet for the 1 ÷ 4 element JetHelix®.



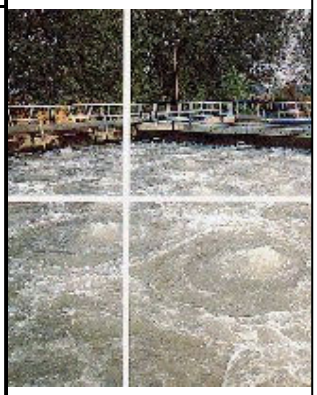
JetHelix® Aerobic Static Diffuser :4-Element equipment

complete equipment , formed by :

- ► PP (Polypropylene) HelieR structured packing
- ► pre-built Concrete anchoring Basement ,
- ► **AISI 304** Stainless Steel supporting Brackets

JetHelix® Static Diffuser : the COMPONENTS

			N°	
A	=	Nuts and Tie Road		
B	=	Heigth of the elements of the Equipment		
C	=	Elements forming the Jet-Helix	4	Pieces
D	=	HelieR Structured Packing , 12" diameter		
E	=	Top		
F	=	Air & Bubbles Sparger		
G	=	Bottom		
H	=	Small Air Bubbles		
I	=	Holes of the Air Piping		



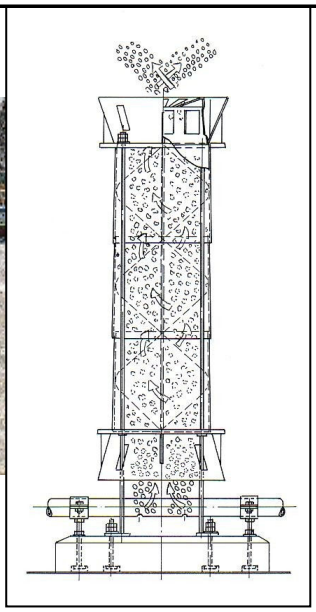
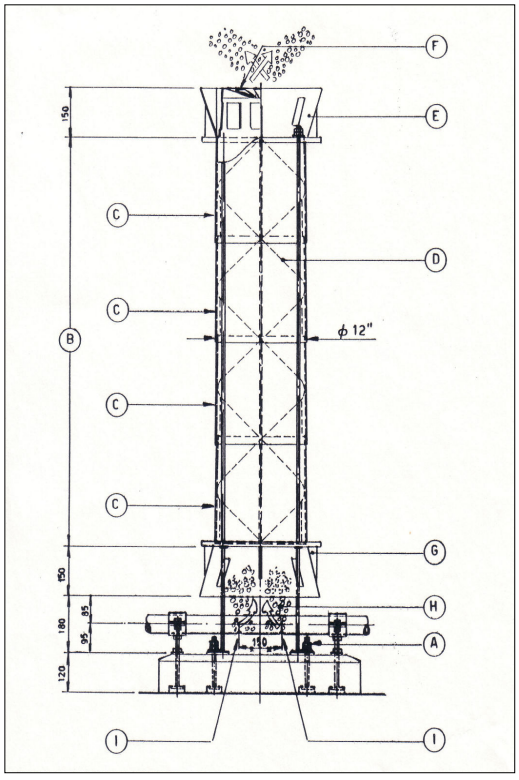


FIG 4 : Air through JetHelix®



JetHelix® Aerobic Diffuser - Main Properties

- ► Available in Different Heights (N° 1 ÷ N° 4 Elements)
- ► 12" Diameter

- ► Small-Fine Air Bubbles
- ► Larger Interfacial Contact
- ► Prolonged Interfacial Contact
- ► Turbulent Flow

- ► High Efficiency : 10 % < η < 30 % in function of Water Depth

- ► High Liquid Mixing = Spiral Mixing , from bottom to top + Radial Mixing

- ► Pumping & Ricirculation Capacity of the Liquid

- ► High Mechanical Resistence
- ► Long Working-Life
- ► No Maintenance

Phone : +39–031–895.374 Partita IVA/C.F. Reg. Imp.MI 13395210159 URL : www.pe-process.it
Fax : +39–031–3524.907 C.C.I.A.A. n. 1647291 Trib. Milano n. 213317 - Cap. soc. i.v. € 99.000,00. E-mail : process@pe-process.it

5) OXYGEN TRANSFER CAPACITY: curves of the oxygen transfer for the JetHelix®system by *P.E.*

The **JetHelix®**Aerobic Static Diffuser, produced and supplied by ***Process Engineering*** , can be of different types :

- the 2- ELEMENT **JetHelix®**– i.e. the equipment 0.90 meter high;
- the 3- ELEMENT **JetHelix®**– i.e. the equipment 1.20 meter high ;
- the 4- ELEMENT **JetHelix®**– i.e. the equipment 1.50 meter high.

The relevant curves for the Oxygen Transfer Capacity give the capacity of the **JetHelix®** equipment to dissolve the oxygen in the water of a basin, where the aeration is performed through the compressed air pumped into the **JetHelix®** equipment.

The curves report the **experimental data** obtained in the tests and give the values for the Transferred Oxygen.
The obtained results – i.e. the transferred oxygen - are measured in : Kg O_2 / h / Equipment .

The **Oxygen Transfer** for the 4-ELEMENT **JetHelix®**equipment is reported in function of :

- the air flow pumped in the **JetHelix®**;
- the water depth of the basin / aeration tank , in which the **JetHelix®**is immersed ;
- the different water depths , under which the **JetHelix®** system has been tested.

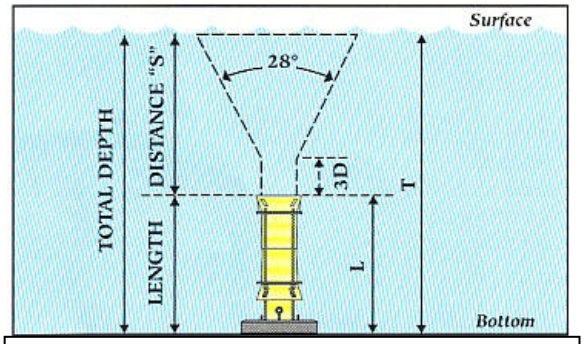


FIG. 5 : JetHelix®– Pumping & Ricirculation Cone

$$Q_T = \frac{Q_L \times S}{3 \times D} \times \eta$$

Q T	=	**Total Delivery** to **Surface** , including entrainment
Q L	=	**Total Delivery** throughout the **Jet-Helix**
S	=	**Distance** S , from muzzle to surface
D	=	**Jet-Helix Diameter**
η	=	**Coefficient**

JetHelix® Diffuser - Suggested Range of Application

WATER DEPTH	EQUIPMENT	
up to 2 m	2- ELEMENT	**JetHelix®**
from 2 m up to 3 m	3- ELEMENT	**JetHelix®**
from 3 m	4- ELEMENT	**JetHelix®**

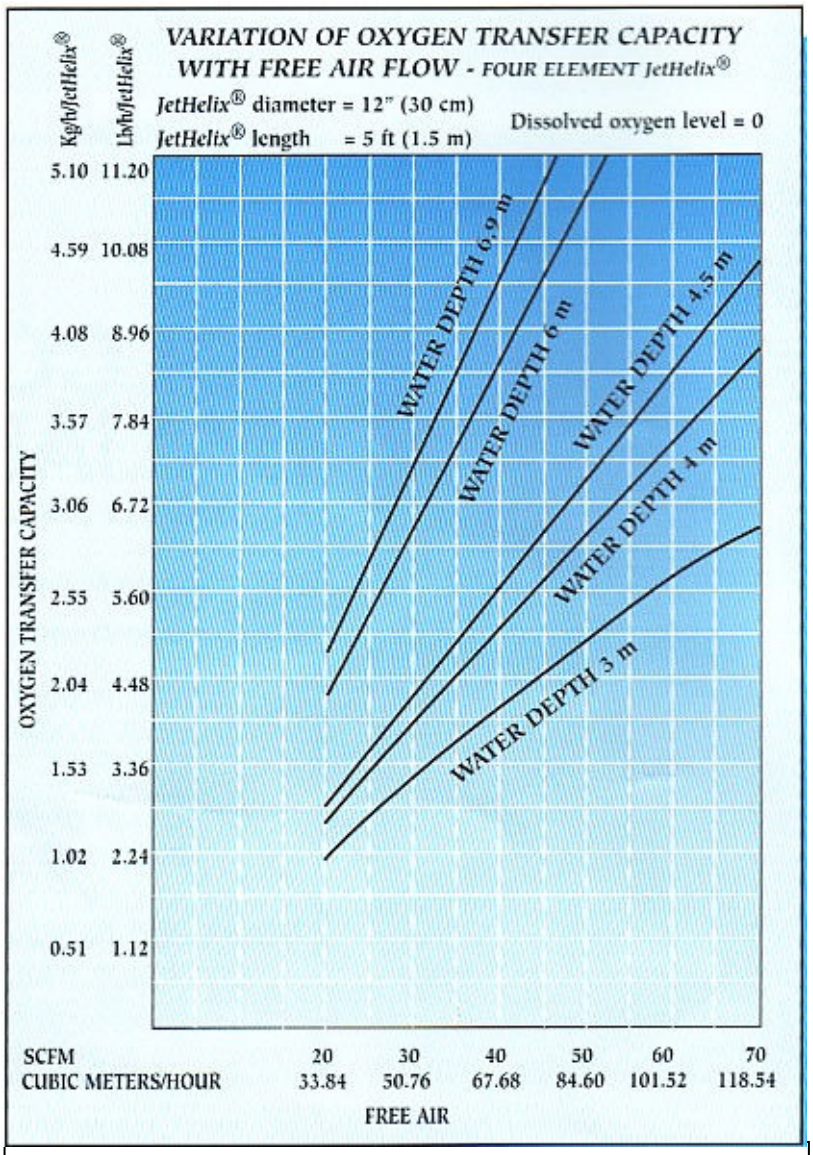


FIG. 6 : 4- ELEMENT JetHelix® – Oxygen Transfer

Phone : +39–031–895.374 Partita IVA/C.F. Reg. Imp.MI 13395210159 URL : www.pe-process.it
Fax : +39–031–3524.907 C.C.I.A.A. n. 1647291 Trib. Milano n. 213317 - Cap. soc. i.v. € 99.000,00. E-mail : process@pe-process.it

7) JetHelix® : Pumping and Flow Curves

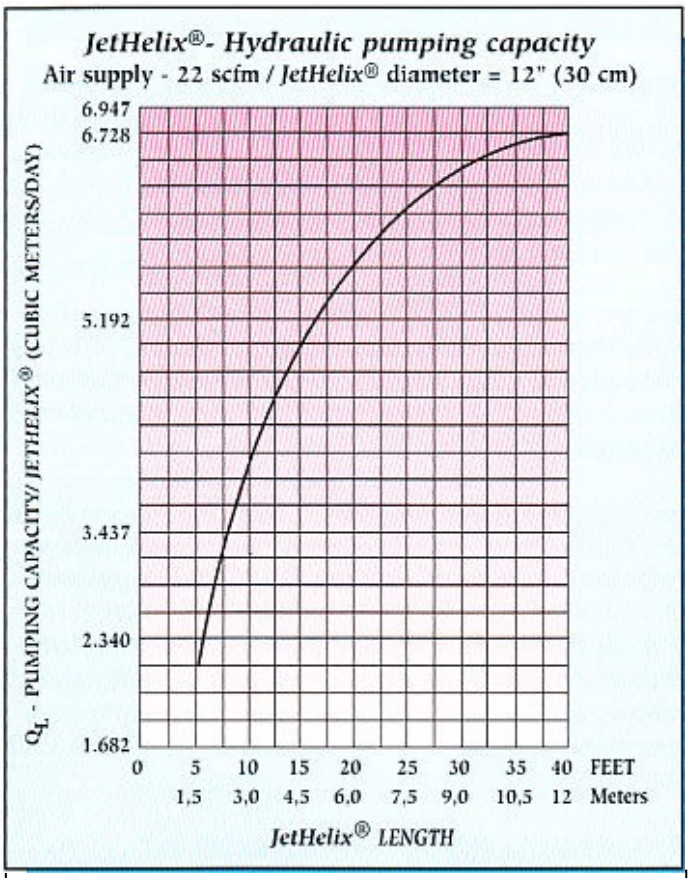


FIG. 7 : JetHelix®- Hydraulic Pumping Capacity

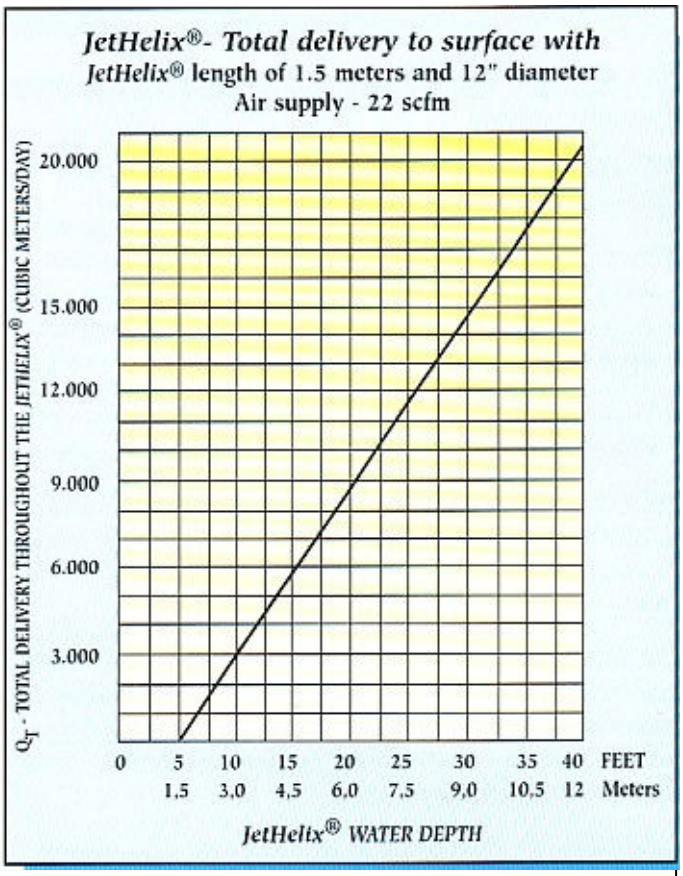


FIG. 8 : Total Delivery to Surface

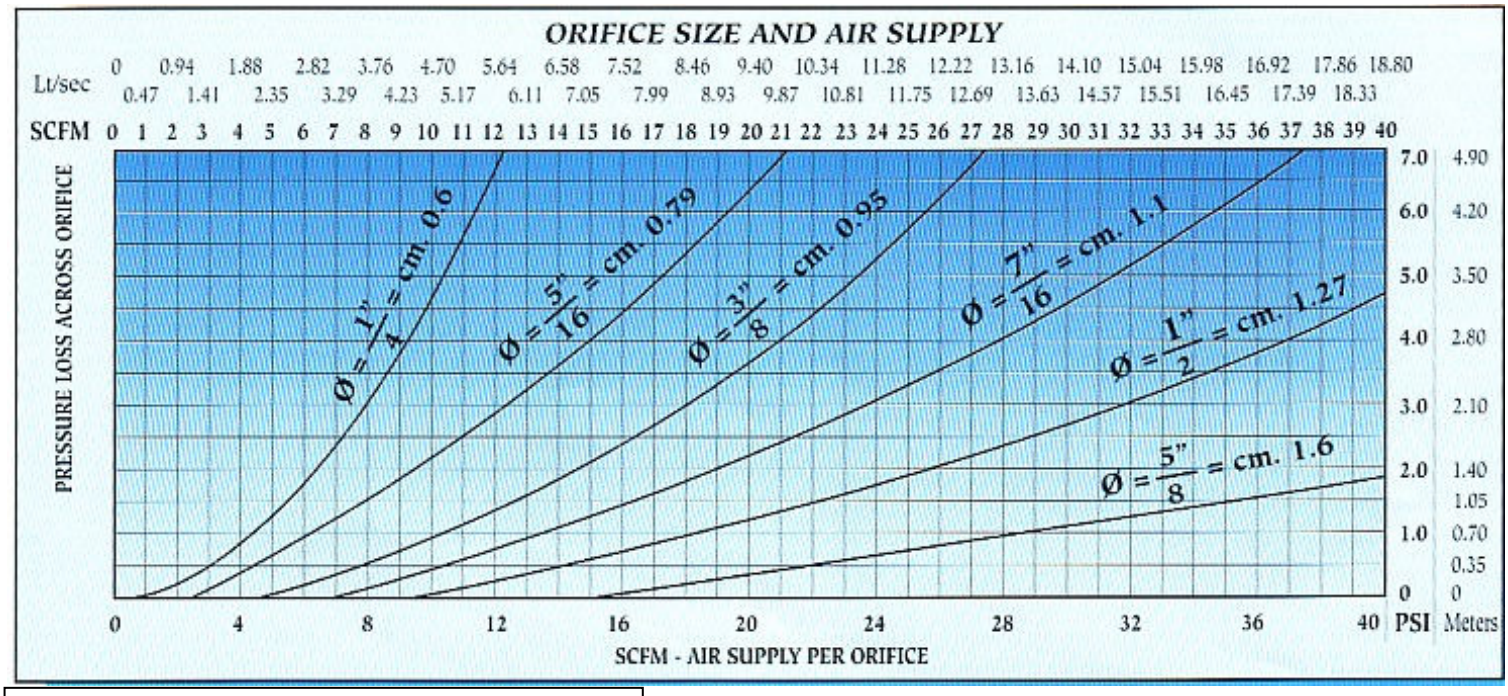


FIG. 9 : Orifice Size VS Air Supply

Phone : +39–031–895.374 Partita IVA/C.F. Reg. Imp.MI 13395210159 URL : www.pe-process.it
Fax : +39–031–3524.907 C.C.I.A.A. n. 1647291 Trib. Milano n. 213317 - Cap. soc. i.v. € 99.000,00. E-mail : process@pe-process.it

8) REFERENCES

- **Equipment Supplied**

Since the invention by Dr Petrillo , our team and organization has :

- more than 5,500 **JetHelix®** Diffuser
- designed and realized Waste Water Treatment Plants for Civil Applications
- designed and realized Waste Water Treatment Plants for Industrial Applications
- successfully installed and started-up the plants supplied .

- **REFERENCES – The Complete Reference List**

Call on us to receive the **Complete Reference List** of the Aeration Systems our organization has supplied **all around the world** , i.e. in the following markets :

- Italy
- Europe and E.U.
- Far-East (Thayland – Malaysia – Indonesia .....)
- China
- Qatar
- Canada
- Pakistan
- ....

- **SUMMARY – Most Significant Supplies**

A SUMMARY of the Most Significant Supplies where the **JetHelix®** System has been successfully applied in Waste Water Treatment plants is here reported :

	Customer	Project	Country	Sector of Application	Description	Supply of :			Flow m3/h	Equivalent Habitants	Maximum COD/BOD
							Pieces	Type			
1	ACQUATER S.p.A.	**AGIP - Venice**	ITALY	Oil & Gas	Effluent Treatment for the Oil Refinery of AGIP PETROLI , Venice	JetHelix®	72	1.5 m H			
2	BIOCHEMICAL	**Iraklion**	GREECE	Civil Wastes	Air Diffusion System for the treatment of Civil Wastes	JetHelix®	170	1.5 m H			
3	Cantoni Finiture Tessili	**Cantoni**	ITALY	Textile	Treatment of the industrial wastes from the textile factory - Saronno , Varese	JetHelix®	120	1.2 m H			
4	DIBRA S.p.A.	**Ceriano Laghetto , MI**	ITALY	Pharmaceutical	Biological treatment of industrial pharmaceutical wastes - Ceriano Laghetto	JetHelix®	274 + 19	1.2 m H	40		
5	FOSTER WHEELER	**" Z.Y.F.P. "**	Zheng Zhou - CHINA	Industrial	Aeration & Mixing Ssytem to treat Industrial wastes	JetHelix®	210	1.5 m H			
6	HOLST ITALIANA S.p.A.	**Ponte a Cappiano , FI**	ITALY	Industrial	Plant to Treat industrial wastes from tannery at Ponte a Cappiano . Florence	JetHelix®	392	1.5 m H			
7	I.A.S. S.p.A.	**Siracusa**	ITALY	Civil & Industrial	Biological Treatment of Industrial and Civil wastes for the Municipality of Siracusa	JetHelix®	250	1.5 m H			
8	Kinopraxia - Midelkos - Moraitis	**Thessaloniki**	GREECE	Municipality	Aeration & Mixing Process to treat the Civil wastes for the Municipality of Thessaloniki	JetHelix®	500	1.5 m H			
9	P.T. Perkebunan III	**PTP III**	INDONESIA	Rubber Industry	Waste Water Treatment for Rubber Thread Extrusion Plant : chemical-physical + aerated & post-aerated lagoons	JetHelix®	368 + 36	1.5 m H			
10	Pharmachim	**Pharmachin**	BULGARIA	Pharmaceutical	Biological treatment of industrial pharmaceutical wastes - Sofia	JetHelix®	250	1.5 m H			
11	Star Water Treatment Co. LTD	**Taipei**	TAIWAN	Civil & Industrial	Air Diffusion System to treat Civil & Industrial Wastes	JetHelix®	102	0.9 m H			
12	TECHNIP ITALY S.p.A.	**ORYX GTL , Ras Laffan**	QATAR	Oil & Gas	Plant to Treat the wastes from ORYX GTL Refinery at Ras Laffan	JetHelix®	378	1.5 m H			125

Phone : +39–031–895.374 Partita IVA/C.F. Reg. Imp.MI 13395210159 URL : www.pe-process.it
Fax : +39–031–3524.907 C.C.I.A.A. n. 1647291 Trib. Milano n. 213317 - Cap. soc. i.v. € 99.000,00. E-mail : process@pe-process.it