SEAWATER INTAKES FOR DESALINATION PLANTS: DESIGN AND CONSTRUCTION

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1. INTRODUCTION
New and bigger desalination plants

Aims of a water intake

- Good water quality
- Low environmental impact
- No entrainment of materials
- Stability
- Little maintenance

New and bigger water intakes
2. TYPES OF WATER INTAKES
There are **three principal types of water intake:**

1. Water intake **at the coast:** Environmental impact and risks due to interaction with coastal dynamics. Low energy consumption.

2. Water intake **at the bottom of the sea:** A structure at the seabed, taking water with specific features.

Main types of water intakes at the bottom of the sea:

Concrete structure
Main types of water intakes at the bottom of the sea:

GRP lantern
Main types of water intakes at the bottom of the sea:

Metallic lantern
3. DESIGN PARAMETERS
1. **Flux direction**: horizontal flux better than vertical (downwards) flux. Upwards flow could be even better.
2. Suction velocity: lower velocity means less organisms and material suction
3. Distance seabed - window: higher distance, lower sand suction
4. **Window depth**: big depth means:

- **High quality of water.**
- **Less wave forces.**
- **Less light and, consequently, less organisms growth.**
- **No bother to navigation.**
5.- Additives against biofouling

An intake with hipochlorite addition out of work
6. Waves at the sea: high waves force against big structures
7. Geotechnical stability: base dimension and weight to avoid overturning, sliding and foundation bearing failure

OVERTURNING

SLIDING

BEARING CAPACITY OF THE FOUNDATION
4. RECENT EXPERIENCES IN WATER INTAKES
DIMENSIONS COMPARISON OF SOME PROJECTED TOWERS (II)
CAMPO DE CARTAGENA

SINKING DEPTH: -26,3 m
SEABED ELEVATION: -25,8 m
LOWER INTAKE ELEVATION: -22,4 m
FLOW RATE: 4,62 m³/s
SUCTION SPEED: 0,20 m/s
TOTAL HEIGHT: 6,15 m
OUTER DIAMETER: 5,30 m
WEIGHT IN AIR OF THE TOWER: 135 t
PLANT OF SKIKDA (ALGERIA)

SINKING DEPTH: -18,5 m
SEABED ELEVATION: -18,0 m
LOWER INTAKE ELEVATION: -13,0 m
FLOW RATE: 2,53 m³/s
SUCTION SPEED: 0,30 m/s
TOTAL HEIGHT: 6,65 m
DIAMETER OF THE CIRCUMSCRIBED CIRCUMFERENCE: 4,74 m
WEIGHT IN AIR OF THE TOWER: 80 t
PLANT OF SKIKDA (ARGELIA)
PLANT OF SKIKDA (ARGELIA)
PLANT OF CAP D’JINET (ALGERIA)
PLANT OF CAP D’JINET (ALGERIA)

SINKING DEPTH: -15,9 m  
SEABED ELEVATION: -15,0 m  
LOWER INTAKE ELEVATION: -12,3 m  
FLOW RATE: 2,64 m³/s  
SUCTION SPEED: 0,29 m/s  
TOTAL HEIGHT: 5,60 m  
DIAMETER OF THE CIRCUMSCRIBED CIRCUMFERENCE: 5,22 m  
WEIGHT IN AIR OF THE TOWER: 140 t
PLANT OF MOSTAGANEM (ALGERIA)

SINKING DEPTH: -16,50 m
SEABED ELEVATION: -16,00 m
LOWER INTAKE ELEVATION: -13,00 m
FLOW RATE: 2,64 m³/s
SUCTION SPEED: 0,19 m/s
TOTAL HEIGHT: 5,10 m
OUTER DIAMETER: 6,20 m
WEIGHT IN AIR OF THE TOWER: 180 t
PLANT OF MOSTAGANEM (ALGERIA)
PLANT OF ÁGUILAS (MURCIA)

SINKING DEPTH: -18,6 m
SEABED ELEVATION: -17,6 m
LOWER INTAKE ELEVATION: -14,1 m
FLOW RATE: 7,14 m³/s
SUCTION SPEED: 0,30 m/s
TOTAL HEIGHT: 6,50 m
OUTSIDE DIAMETER (BODY OF THE TOWER): 5,30 m
WEIGHT IN AIR OF THE TOWER: 160 t
PLANT OF ÁGUILAS (MURCIA)
PLANT OF MUTXAMEL (ALICANTE-SPAIN)

SINKING DEPTH: -12.5 m
SEABED ELEVATION: -8 m
LOWER INTAKE ELEVATION: -5.7 m
FLOW RATE: 1.85 m³/s
SUCTION SPEED: 0.14 m/s
TOTAL HEIGHT: 8.5 m
SIDE LENGTH: 3.65 m
PLANT OF SANTA EULALIA (IBIZA-Spain)

SINKING DEPTH: -21.7 m
SEABED ELEVATION: -20 m
TOTAL HEIGHT: 4.85 m
SIDE LENGTH 4 m
PLANT OF NUNGUA (GHANA)

SINKING DEPTH: -10.6 m
SEABED ELEVATION: -8.8 m
LOWER INTAKE ELEVATION: -5.7 m

TOTAL HEIGHT: 5.1 m
SIDE LENGTH (BODY OF THE TOWER): 3.1 m

FLOW RATE: 1.32 m³/s

WEIGHT IN AIR OF THE TOWER: 95 t
PLANT OF MANTOVERDE (CHILE)

SINKING DEPTH: -19 m
SEABED ELEVATION: -18 m
TOTAL HEIGHT: 4.20 m
OUTSIDE DIAMETER (BODY OF THE TOWER): 2.0 m
FLOW RATE: 3.6 m³/s
WEIGHT IN AIR OF THE TOWER: 20 t
PLANT IN THE MEDITERRANEAN SEA (I)

CONSTRUCTION IN TWO PARTS, connected with in situ mass concrete filling.
- SINKING DEPTH: -21.6 m
- SEABED ELEVATION: -14 m
- TOTAL HEIGHT: 15.8 m
- DIAGONAL OF OCTOGONAL BASE: 10.2 m
- FLOW RATE: 10.12 m$^3$/s
- MINIMUM DISTANCE REQUIRED FROM THE NATURAL BOTTOM TO THE LOWER PART OF THE INTAKE WINDOWS = 5 m
- SUCTION SPEED < 0.15 m/s
- TOTAL WEIGHT IN AIR IN SERVICE (concrete + granular filling): 1320 t
PLANT IN THE MEDITERRANEAN SEA (II)
PLANT IN THE MEDITERRANEAN SEA (III): LOWER PART

• TOTAL HEIGHT: 7.6 m
• DIAGONAL OF OCTOGONAL BASE: 10.2 m
• TOTAL WEIGHT IN AIR (only concrete): 340 t
PLANT IN THE MEDITERRANEAN SEA (IV): LOWER PART

• TRANSPORTATION AND SINKING: AUXILIARY FLOATS
PLANT IN THE MEDITERRANEAN SEA (V): LOWER PART

• TRANSPORT AND SINKING: AUXILIARY FLOATERS
PLANT IN THE MEDITERRANEAN SEA (VI): UPPER PART

- TOTAL HEIGHT: 8.2 m
- DIAGONAL OF OCTOGONAL PART: 7.5 m
- HEIGHT OF WINDOWS: 3 m
- DIAMETER OF CYLINDER: 3.5 m
- TOTAL WEIGHT IN AIR: 76 t
WHAT DID WE LEARN ABOUT WATER INTAKE STRUCTURES AT THE SEABED?

1. MARINE CLIMATE (WAVES) SHOULD BE CAREFULLY ANALYSED.
2. DESIGNS SHOULD BE ADAPTED TO THE AVAILABLE MEANS.
3. BEST MATERIALS: CONCRETE, GRP AND STAINLESS STEEL.
4. THICK ELEMENTS OF CONCRETE HAVE MANY ADVANTAGES: STRUCTURAL CAPACITY AND LARGER STABILITY.
5. IF USING GRATES, THEY SHOULD BE “EASY TO CLEAN OR DISMANTLE”.
6. SOMETIMES IT COULD BE USEFULL TO MAKE A CFD STUDY TO ASSESS FORCES AGAINST THE STRUCTURE AND THUS OPTIMIZE THE DESIGN.
ADVICES FOR THE PIPE CONNECTING THE INTAKE TO LAND:

1. JOINTS BETWEEN PIPES SHOULD BE CAREFULLY DESIGNED AND CONSTRUCTED.

2. PE IS THE MOST APROPRIATE MATERIAL.

3. AT THE SUFZONE, INSTALL IT INSIDE A TRENCH OR A TUNNEL.

4. INSTALL MANHOLES EVERY 300 M (APROX).
THANK YOU FOR YOUR ATTENTION!
If you need further information, do not hesitate to contact us.

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