Doosan Heavy Industries & Construction

Integrated solutions for a better life

DOOSAN WATER PLANTS
WATER AND WASTEWATER TREATMENT

DOOSAN *Building your tomorrow today*

INTEGRATED SOLUTIONS FOR A BETTER LIFE

Waterford WWTP

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A growing population, rapid urbanization and industrialization have made natural sources of quality water for potable and industrial use increasingly scarce globally. Contamination of water resources and more stringent discharge regulations demand more advanced and cost-effective water treatment technology. One increasingly popular alternative is to recycle treated wastewater. In many cases, the cost of treating wastewater for reuse or recycling is less than other methods of production with the added advantage of conserving precious water resources.

Doosan Heavy Industries & Construction along with two subsidiaries, Doosan Enpure in the UK and Doosan Hydro Technology in the US, provide solutions in a wide range of water and wastewater treatment & reclamation, both in the public and private sectors. We offer tailor-made solutions to pinpoint your needs through our engineering capabilities and experience. In addition to the conventional processes, we provide state-of-the-art water treatment processes, such as membrane-based technology and advanced oxidation process, as part of integrated solutions, ensuring a cost-effective benefit to the client.

We are ready to serve industrial sector clients to handle water supply, treatment and recycle issues combining our proven desalination technologies and experience with conventional technologies. In addition, a full range of delivery options including EP, EPC, DBO, and BOT are available to meet your needs.

DOOSAN HEAVY INDUSTRIES & CONSTRUCTION

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Main Business Portfolio

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EPC | Power | **Water** | Nuclear Power | Castings & Forgings

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Business Portfolio

Water Treatment	Desalination	Operation & Maintenance
Advanced Water Treatment	Multi-Stage Flash (MSF)	Desalination Plants
Municipal Wastewater Treatment & Reclamation	Multi-Effect Distillation (MED)	Water & Wastewater Treatment Plants
Industrial Water & Wastewater Treatment	Reverse Osmosis (RO)	

WATER AND WASTEWATER TREATMENT PLANTS **BUSINESS AREAS**

WATER TREATMENT PLANTS
DRINKING WATER

General

Conventionally, the main purpose of water treatment is to remove solids, turbidity and pathogenic micro-organisms. Recently, however, to reduce the risk to public health, more and more countries are introducing new drinking water regulations containing stricter limits on pathogens and naturally occurring compounds.

Doosan Heavy Industries & Construction provides optimized solutions from conventional systems, which consist of coagulation & flocculation, sedimentation, media filtration, and disinfection, to state-of-the-art technology such as membrane-based or advanced oxidation process (AOP). In addition, Doosan provides effective intake systems and distribution networks in order to provide high quality drinking water every single day.

Highlighted Project

Elvington Water Treatment Plant

- **Client :** Yorkshire Water, UK
- **Capacity :** 270,000 m^3/d
- **Contract value :** £10 Million
- **Process selection :**
  - Coagulation-flocculation
  - Sedimentation
  - Sand filter
  - AOP (Ozone) system
  - GAC
  - Disinfection

Major References

Project	Client	Country	Main Process	Completion year	Capacity (m^3/d)
Croton*	City of New York. Hazen and Sawyer	USA	DAF	2012	1,101,000
Assynt WTP	Scottish Water Solutions Glyn Lloyd	UK	DAF	2010	20,000
Hornsey WTP	Costain – Simon Roberts	UK	DAF, DMF, GAC	2010	53,000
Badentinan Membrane WTP	Scottish Water Solutions	UK	UF	2009	25,000
Farmoor WTP Combined Scheme	Costain for Thames Water Utilities Ltd	UK	Filtration, GAC	2009	120,000
Venice Gardens WTP	Sarasota County Government	USA	DMF, RO	2009	7,000
City of Hollywood	City of Hollywood	USA	DMF, RO	2009	8,000
Longue Hogue WTP	Guernsey Water	UK	UF	2008	15,000
Barrow WTP	Bristol Water PLC	UK	Ozone, DAF, DMF	2004	120,000
St Saviours Reservoir	States of Guernsey Water Board	UK	UF	2004	13,000
Seedy Mill WTP	South Staffordshire Water PLC	UK	GAC, UF	2003	148,000
Handois WTP	Jersey New Waterworks Company Ltd	UK	UF, RO	1999	20,000
Ipoh WTP	Metropolitan Utilities Corporation for Lembaga Air Perak	Malaysia	DAF	1999	275,000
Elvington WTP	Yorkshire Water	UK	Ozone, GAC	1997	270,000
Liuzhou Liuxi WTP *	Guanxi Province	China	Conventional Type	1997	300,000
Graincliffe WTP	Yorkshire Water	UK	DAF, Filtration	1993	60,000

Note :
* Engineeing work and main equipment provision only

DAF : Dissolved Air Floatation
DMF : Dual Media Filtration
UF : Ultra Filtration
GAC : Granular Activated Carbon
RO : Reverse Osmosis

WATER TREATMENT PLANTS
INDUSTRIAL WATER

General

Inevitably, most industries need water and more technologically intensive industries require larger quantities of higher quality water. Quantity and quality of water become a key factor influencing all stages from plant operations to shut-downs in industries.

Doosan Heavy Industries & Construction provides cost-effective and reliable industrial water supply systems for all kinds of water resources to achieve stable manufacturing and plant operations in a variety of industries including power plants, petrochemical & oil refineries, semiconductors, beverage, and pharmaceuticals.

Highlighted Project

Cebu CFB Demineralization Plant

- **Client :** Kepco SPC Power Corporation
- **Capacity :** 2,880 m^3/d
- **Contract value :** $4.9 Million
- **Process selection :**
  - Seawater Intake Facility (Screen)
  - Auto Strainer + UF
  - SWRO + BWRO
  - EDI

Major References

Project	Client	Country	Featured Process	Completion Year	Remark
Jebel Ali 'M' Power Plant	DEWA	UAE	Demineralization	Ongoing	CCPP
Daharki Power Plant	Foundation Power Company (Daharki) Ltd.	UAE	Pre-Treatment, RO, Demineralization	Ongoing	CCPP
Qatalum Power Plant	Hydro Aluminum AS	Qatar	Demineralization	Ongoing	CCPP
Cebu CFB Power Plant	KSPC (KEPCO+Salcon)	Phlippines	Demineralization	Ongoing	TPP (Coal)
Cirebon Power Plant	PT. Cirebon Electric Power	Indonesia	Demineralization	Ongoing	TPP (Coal)
Rabigh Power Plant #2	SEC	KSA	Demineralization	Ongoing	TPP (Oil)
Mong Doung II Power Plant	Mong Power Company Ltd.	Vietnam	Pre-Treatment, RO, Demineralization	2012	TPP (Coal)
Ecopetrol	Ecopetrol	Colombia	UF, RO	2012	Petrochemical Plant
Kawasaki	Kawasaki Heavy Industries Co.	Turkmenistan	Pre-Treatment, RO, Demineralization	2012	Chemical Plant
Amman East Power Plant	AES Jordan PSC	Jordan	Pre-Treatment, RO, Demineralization	2009	CCPP
Barka Power and Desalination Plant Ph.2	Ministry of National Economy	Oman	Demineralization	2009	CCPP
Sohar Power and Desalination Plant	Sohar Power Company S.A.O.C	Oman	Demineralization	2007	CCPP
Pepsi Cola (Baltimore, Newport, Riviera Beach)	Pepsi-Cola	USA	UF, RO	2007	Food & Beverage Plant
Rehab Power Plant	Central Electricity Generating Company	Jordan	Pre-Treatment, RO, Demineralization	2005	CCPP
LUS - Hargis Herbert Power Plant	The Industrial Company	USA	Pre-Treatment, RO, Demineralization	2005	NGPP
Busan Power Plant	Korea Southern Power Corp.	Korea	Demineralization	2003	CCPP
Youngdong Power Plant	Korea South-East Power Corp.	Korea	Demineralization	2003	TPP (Coal)
Umm Al Nar Desalination Station B	Abu Dhabi Water & Electricity Authority	UAE	Demineralization	2002	CCPP
Kondapalli Power Plant	Lamco Kondapalli Power Privited Ltd.	India	Pre-Treatment, Demineralization	2001	CCPP
Yonggwang Nuclear Power Plant #1,2,3,4,5,6	Korea Electric Power Corp.	Korea	Demineralization, CPP	2001	NPP
Tangjin Power Plant Units #1,2,3,4	Korea Electric Power Corp.	Korea	Demineralization, CPP	1999	TPP (Coal)
Kori Nuclear Units #1,2	Korea Electric Power Corp.	Korea	Demineralization	1998	NPP
Hadong Power Plant Units #5,6	Korea Electric Power Corp.	Korea	Demineralization, CPP	1998	TPP (Coal)
Hanlim Power Plant	Korea Electric Power Corp.	Korea	Pre-Treatment, Demineralization	1997	CCPP
Midland	DOW	USA	DAF	2015	Chemical Plant

RO : Reverse Osmosis
CPP : Condensate Polishing Plant
UF: Ultra Filtration

CCPP : Combined Cycle Power Plant
TPP : Thermal Power Plant
NGPP : Natural Gas-fired Power Plant
NPP : Nuclear Power Plant

WASTEWATER TREATMENT PLANTS
MUNICIPAL WASTEWATER TREATMENT AND REUSE

General

National and local governments are spending vast sums to expand and improve their wastewater treatment infrastructure. They are faced with daily challenges to meet the increased demand caused by growing populations, more stringent regulations, dwindling traditional water supplies and aging equipment.

Depending upon geography, climate, food style and sewage network systems, each municipal wastewater treatment system has unique characteristics and diurnal & seasonal patterns. Thus, in order to provide an adequate solution, the supplier or contractor should have diverse experience. Doosan Heavy Industries & Construction has completed municipal wastewater treatment projects in East Asia, Europe, the Middle East, North Africa and North America giving us experience in a wide range of scenarios.

With our high technological capacity, we create optimized solutions, converting conventional treatment methods such as oxidation ditches into water reuse systems through MBR and RO technologies. In addition, we can provide sewage systems and treated effluent network systems with pumping stations.

Highlighted Project

Luggage Point Wastewater Treatment Plant

- **Client :** Brisbane Water, Australia
- **Capacity :** 216,000 m³/d
- **Contract value :** $18 Million
- **Process selection :**
  - Screen/Grit removal
  - Primary clarifier
  - Activated sludge system (BNR)
  - Secondary clarifier
  - DAF thickening-dewatering
  - Odor control

Major References

Project	Client	Country	Featured Process	Completion Year	Capacity (m^3/d)
GWRS	McCarthy Building Companies, Inc	USA	RO	On Going	19,000
Western Corridor, Luggage Point AWT	Nandah Alliance	Australia	UF, RO	2010	87,800
Waterford WWTP	AWI for Waterford County Council	Ireland	ASP	2009	82,426
Hakik WWTP	Incheon City	Korea	MBBR	2008	125,000
Jinju WWTP	Jinju City	Korea	BNR	2008	150,000
Daesanmyeon WWTP	Haman Gun	Korea	BNR	2006	13,000
Bangeojin WWTP	Ulsan City	Korea	BNR	2005	100,000
Lowestoft WWTP	Anglian Water	UK	MBBR, MBR, DAF	2002	60,480
Quillota WWTP	Esval	Chile	BNR	2002	63,590
Luggage Point WWTP	Brisbane Water	Australia	BNR	2001	864,000
Bromborough WWTP	United Utilities	UK	BAFF	2000	60,912
Falmouth WWTP	South West Water	UK	CAS	2000	23,587
Great Billing WWTP	Anglian Water	UK	BNR	2000	91,000
Pyewipe WWTP - Phases 1 & 2	Anglian Water	UK	MBBR	1999	80,784
Corby WWTP	Anglian Water	UK	MBBR	1998	56,256
Moa Point WWTP	Wellington City Council	New Zealand	MBBR / ASP	1998	345,600
Harwich & Dovercourt WWTP	Anglian Water	UK	ASP	1997	103,680

BNR : Biological Nutrient Removal
ASP : Activated Sludge Process
SBR : Sequencing Batch Reactor
MBBR : Moving Bed Bio Reactor
MBR : Membrane Bio Reactor
DAF : Dissolved Air Floatation
BAFF : Biological Aerated Flooded Filter
UF : Ultra Filtration
RO : Reverse Osmosis

WASTEWATER TREATMENT PLANTS
INDUSTRIAL WASTEWATER TREATMENT AND REUSE

General

Despite recent trends in the developed world to minimize wastewater production or increase recycling, many industries remain dependent on processes that produce wastewater.

Unlike municipal wastewater, industrial wastewater may contain a number of toxic materials depending on the industry. Although some materials can be removed by simple treatment processes, generally, a combination of physical, chemical and biological treatment processes need to be applied.

Doosan Heavy Industries & Construction has a variety of experiences in developing wastewater systems for SWRO desalination and power plants. In addition, we are currently constructing a ZLD system for the petrochemical wastewater treatment project, SEP U&O in Saudi Arabia.

Highlighted Project

Jeddah Ph.3 SWRO Desalination Plant WWTP

- **Client :** Saline Water Conversion Corporation (SWCC), KSA
- **Capacity :** 25,392 m³/d
- **Process selection :**
  - Rectangular sedimentation
  - Sludge dewatering (Centrifuge decanter)
  - Sludge dryer

Jebel Ali M Power Plant WWTP

- **Client :** Dubai Electricity & Water Authority (DEWA), UAE
- **Capacity :** 400 m³/d
- **Process selection :**
  - Rectangular sedimentation
  - Sludge dewatering (Centrifuge decanter)

Major References

Project	Client	Country	Completion Year	Description
Daharki Power Plant	Foundation Power Company (Daharki) Ltd.	UAE	Ongoing	CCPP
Qatalum Power Plant	Hydro Aluminum AS	Qatar	Ongoing	CCPP
Cebu Power Plant	KEPCO SPC Power Corporation	Philippines	Ongoing	TPP (Coal)
Cirebon Power Plant	Cirebon Electric Power	Indonesia	Ongoing	TPP (Coal)
SEP U&O	Daelim	KSA	Ongoing	Petrochemical Plant
Ras Al Khair RO Plant	SWCC	KSA	2014 (Expected)	SWRO
Jeddah Ph.3 RO Plant	SWCC	KSA	2013	SWRO
Jebel Ali 'M' Power Plant	DEWA	UAE	2013	CCPP
Shuwaikh RO Plant	MEW	Kuwait	2011	SWRO
Amman East Power Plant	AES Jordan PSC	Jordan	2009	CCPP
Barka Power and Desalination Plant Ph.2	Ministry of National Economy	Oman	2009	CCPP
Shuaiba III RO Plant	SWCC	KSA	2009	SWRO
Yonghung Power Plant Units #1,2,3,4	Korea South-East Power	Korea	2008	TPP (Coal)
Sohar Power and Desalination Plant	Sohar Power Company S.A.O.C	Oman	2007	CCPP
Avlon Effluent Treatment Plant	Astra Zeneca	UK	2006	Pharmaceutical ETP Plant
Shoaiba Desalination Plant	SWCC	KSA	2003	SWRO
Fujairah Water and Power Plant	UAE Offsets Group	UAE	2003	SWRO
Panweol Power Plant	Panweol Industrial Complex Corporation	Korea	2002	CCPP
Yukong CLX Plant	Sunkyong	Korea	1996	Refinery Complex

SWRO : Seawater Reverse Osmosis
CCPP : Combined Cycle Power Plant
TPP : Thermal Power Plant

SLUDGE TREATMENT AND ENERGY RECOVERY SYSTEMS

General

Sludge treatment has traditionally focused only on dewatering to minimize the mass of wet solids for disposal. Increasingly, legislation requires sludge to meet minimum standards for hygiene and toxicity. Additionally, the organic content of the sludge is seen as a resource, in particular as a feedstock for anaerobic digestion, providing biogas for power generation and heat to run the process.

Doosan Heavy Industries & Construction can provide a wide range of sludge treatment processes to meet all legislative requirements as well as maximize the return of energy and other useful components of the sludge stream. These systems include thermal and sonic pre-treatment, pasteurization, thermophilic and mesophilic digestion, dewatering and drying.

Highlighted Project

Ringsend Sludge Treatment Plant Extension

- **Client :** CAW for Dublin Council, Republic of Ireland
- **Capacity :** 120 t dry-solid/d
- **Process selection :**
  - Drum thickener
  - Centrifuge thickener
  - Anaerobic digester with tube mixer
  - Two belt thickener / Press
  - Thermal Hydrolysis

Major References

Plant	Client	Country	Featured Process	Completion Year	Capacity (m^3/d)
Bellozane WwTW Phase II	States of Jersey	Island of Jersey	AD	2015	10.6 tDS/d
Esholt WWTP Digestion Plant	Morgan Est (Yorkshire Water)	UK	AD	2009	34.1 tDS/d
Jebel Ali Thermal Sludge Dryer (3 No. BT3000/12)	Al Ahmadiah Aktor	UAE	SD	2009	70.8 tDS/d
Ringsend WWTP Sludge Plant Extension	Dublin City Council	Ireland	THP, AD	2009	56 tDS/d extension 120 tDS/d total capacity
Minworth WWTP Sonix Ultrasound Plant	Severn Trent Water	UK	SONIX	2007	1,700,000 PE
Beenyup WWTP – Sonix Ultrasound Plant	Bennyup Water Services on behalf of Water Corporation of Perth	Australia	SONIX	2004	600,000 PE
Lowestoft WWTP	Anglian Water	UK	Past, AD, CHP	2002	405,000 PE
Bromborough WWTP	North West Water	UK	AD	2000	180,000 PE
Pyewipe WWTP	Anglian Water	UK	AD, SD	1999	39.7 tDS/d
Millbrook WWTP	Southern Water	UK	AD, SD	1998	40 tDS/d
Cliff Quay WWTP (Ipswich)	Anglian Water	UK	AD	1997	19.5 tDS/d

THP : Thermal Hydrolysis Process
AD : Anaerobic Digestion
SD : Sludge Drying
Past : Sludge Pasteurisation
SONIX : Sludge Sonification
CHP : Combined Heat and Power

ZERO LIQUID DISCHARGE SYSTEM

General

Zero liquid discharge (ZLD) is the most advanced wastewater treatment technology currently available. It can achieve no or minimized effluent and highly purified recycled water. The ZLD system is applied for limited wastewater fields which are small and can be hard to treat using conventional treatment systems and in water-intensive industries, such as refineries, petrochemical plants, IGCC and FGD power plants. Recently, due to increasing focus on environmental and social issues as well as cost effectiveness, the ZLD system has been expanding to an increasing number of usages.

Generally, the ZLD system is based on high pressure reverse osmosis (RO) or thermal evaporation technology. EEach ZLD system is designed to meet site-specific needs and combines a number of wastewater treatment technologies including lime softening, biological treatment, MF/UF, and evaporation ponds.

Doosan Heavy Industries & Construction is currently leading the high-capacity evaporator market, Multi-Stage Flash (MSF) and Multi-Effect Distillation (MED), and has significant experience in creating combined systems through SWRO and municipal & industrial wastewater treatment projects.

Currently, our 120m³/day capacity pilot plant is fully operational and we are in the process of scaling it up to a capacity of 1MIGD (4,546m³/day).

Highlighted Project

ZLD System Pilot Plant

- **Location** : Changwon, Korea
- **Capacity** : 120 m³/d
- **Process selection** :
  - Mechanical Vapor Compression Falling Film Evaporator
  - Thermal Vapor Compression Falling Film Evaporator
  - Forced Circulation Crystallizer

RESEARCH & DEVELOPMENT

1 Zero Liquid Discharge (ZLD)
2 High-efficiency SWRO System
3 Low-energy Membrane Bioreactor (MBR)
4 Once-Through Long-Tube pilot Plant
5 Dammam R&D Center
6 Birmingham R&D Center

Doosan actively conducts its water-related research and development activities at its four dedicated R&D centers in Seoul and Changwon, Korea; Dammam, KSA; and Birmingham, UK. The main goal of our R&D centers is to create and launch needs-driven water systems that will introduce brand-new solutions to the water market. Main R&D topics include:

- Eco-friendly process including ZLD systems
- High-efficiency water reuse technologies
- Concentrated Solar Power (CSP) Desalination
- Doosan Fiber Filter system
- Low-energy MBR technologies
- Sludge treatment technologies
- Technologies for optimal operation & maintenance of desalination processes
- New Bubble Generation Dissolved Air Flotation (NBG-DAF)

DOOSAN ENPURE

The UK-based subsidiary Doosan Enpure is a process engineering company with proven design, technology and project delivery credentials in the water and wastewater treatment sectors.

Doosan's water treatment business provides a full range of services for water and wastewater treatment: engineering, procurement, construction as well as operation and maintenance. Through our accumulated know-how in membrane technologies and EPC experiences around the globe, we offer differentiated solutions to satisfy clients' various needs.

- Advanced Water Treatment
  - Advanced water treatment solutions including membrane technologies and also in-house technologies such as Dissolved Air Flotation (DAF)

- Municipal Wastewater Treatment and Reclamation
  - Advanced treatment & reclamation solutions including media and membrane filtration
  - Biological Nutrient Removal (BNR) process
  - Membrane Bioreactor (MBR) process
  - Pasteurisation (Puriser) process - anaerobic digestion

- Industrial Water & Wastewater Treatment
  - Pre-treatment and wastewater treatment systems for RO desalination plants
  - Water supply and wastewater treatment systems for power plants
  - Produced water treatment solutions for the oil & gas industry
  - Zero Liquid Discharge (ZLD) system

WATER AND WASTEWATER TREATMENT PLANTS **CASE STUDIES**

CASE STUDY CONTENTS

CASE STUDY: Barrow Water Treatment Plant

- **Client :** Bristol Water plc / UK
- **Capacity :** 120,000 m³/d
- **Contract Value :** £15.4 Million
- **Scope :** Low lift pumps, ozonation, flotation, RGF's sludge thickening
- **Contract Completion :** October 2004

• General

Barrow is a large potable water treatment works, which is fed with raw water from the three storage reservoirs at Barrow. The reservoirs designated reservoirs 1, 2 & 3 receive water via Notting Hill gauge tank via Chew & Blagdon surface reservoirs and the Mendip Springs. The proportions of flow from each of these sources can be selected by the operators and therefore the quality of raw water entering the three reservoirs at Barrow can be controlled to achieve the best raw water quality within the constraints of the system. The existing treatment at Barrow consisted of microstrainers, slow sand filters complete with washing plant, chlorine contact tank & high lift pumps. Doosan Enpure undertook construction of a pre-treatment plant prior to the existing slow sand filters to alleviate problems associated with poor water quality.

• Process Description

As per Bristol Water's request a compliant scheme was tendered, however after reviewing the raw water data available it was concluded that during periods of very high algal blooms the RGFs proposed as part of the compliant scheme were unprotected and would ultimately be unable to cope with the load and seal. We also quoted an alternative bid that was eventually taken up by Bristol Water which included a flotation process before the RGFs to protect the filters from the algae loadings. This system was based on the DAFrapide integrated design approach developed from the conventional flotation system offered by ENPURE for a number of years. Six No. streams complete with flocculation followed by ten No. RGFs. The pre-treatment process for Barrow WTW is a low lift pumping station incorporating duty, standby variable speed pumps, inlet works, ozonation including contact tank, flashmixing prior to the flocculation and flotation stage, and then RGFs. Dirty backwash water from the RGFs gravitates down to three dirty washwater recovery tanks where the sludge is settled and transferred to the sludge treatment process and clean supernatant is returned either to the reservoir or the inlet works. The sludge thickening stage includes WRc thickeners, polymer dosing, holding tanks and belt press.

• Conclusion

Initial flows through the plant took place on May 20th, 2004, and the quality of the treated water has continued to comply with the contractual requirements. A formal 28 take-over test was carried out during October 2004, and the treated water guarantees were all met. This was a challenging project, with the client being fully satisfied with the final quality of the DAF/RGF installation and the treated outcomes being achieved at Barrow.

CASE STUDY: Lowestoft Wastewater Treatment Plant

- **Client :** Anglian Water Services Ltd. / UK
- **Capacity :** 60,000 m³/d
- **Contract Value :** £75 Million
- **Scope :** Flagship new build sewage treatment works for Lowestoft / Scope included supply, construction, installation, commissioning and operations, including new preliminary, primary, secondary and sludge treatment facilities (with dedicated industrial waste stream treatment)
- **Contract Completion :** January 2002

• General

Anglian Water Services Limited awarded Doosan Enpure part of the £75 million main contract for work at Lowestoft Wastewater Treatment Works in Suffolk. The purpose of the Project was to provide treatment facilities for the major conurbations in the catchment area including Lowestoft, Pleasurewood, Corton, Blundeston and the industrial arisings from BirdsEye Walls and SFS. The Doosan Enpure scope comprised new preliminary, primary, secondary and sludge treatment facilities and included supply, construction, installation, commissioning and operation of the plant for one year post project completion. There had been extreme public concern in the area providing many challenges to overcome. The decision was made to provide a fully enclosed works with state of the art odour control facilities incorporating double and triple containment.

• Process Description

The focus of the design was on environmental sustainability including water reuse with provision of MBR's for high quality wash water and irrigation use, OPEX savings from purchase of high speed turbo blowers, sludge recycling with the production of a Class A product allowing safe disposal route to land, CHP generation utilising biogas for gas engines, and sludge minimisation with the provision of helical spiral separators and thermophilic digestion. Many novel processes have been incorporated into the highly innovative Lowestoft design, which include Primary lamella Plant, Re-Aeration (60% flows), Kaldnes DAF (1/5th flows), MBR (1/5th flows), Industrial Treatment, Sludge Treatment, Odour Control and CHP. The design was based on 267,000 PE / 16,000 kg BOD, 267,000 PE / 16,000 kg BOD.d Industrial Load, 138,000 PE / 8,327 kg BOD.d Domestic Load, Flows are Min 290 l/s, Avg 382 l/s, Max 700 l/s. The area of the dome covers 14,200 m2 equivalent to 1 ½ hectares and the area of the site as a whole is 134,000 m^2 or 14 hectares. 14,000 m^3 of concrete was used during construction and 120 km of cabling installed.

• Conclusion

Lowestoft WWTP is a perfect example of innovative technology being applied in an environmentally sustainable way. It is anticipated to be an excellent reference site for key processes currently being developed for future waste water treatment technology. The Works is unique in that novel technologies developed have been provided under one roof allowing designs to be demonstrated as well as operational ability, to future clients. The project also allows different processes to be challenged under controlled load and flow variations beyond normal design, which in turn will improve competitiveness.

CASE STUDY: Moa Point Wastewater Treatment Plant

- **Client :** Wellington City Council / New Zealand
- **Capacity :** 345,600 m³/d
- **Contract Value :** NZ$149 Million
- **Scope :** Design, build and operate
- **Contract Completion :** October 1998

• General

Wastewater treatment for the 250,000 citizens of Wellington, New Zealand's capital city, originally consisted of preliminary treatment using screens, followed by discharge straight into the sea. Through Anglian Water International, Doosan Enpure was involved in the NZ$149 million contract to design, build and operate state-of-the-art treatment works at Moa Point - close to the airport - and a smaller plant serving the suburb of Karori for Wellington City Council. Anglian Water is operating the facilities for 21 years.

The project became fully operational in October 1998 and comprises the design, construction, commissioning and operation of:

- a small, self-contained treatment plant at Karori (10,000 pe);
- the main treatment plant at Moa Point (240,000 pe), located alongside Wellington Airport;
- a 1.8 km outfall pipe into Cook Strait;
- a twin sludge pipeline extending some 8.7 km through several suburbs and native bush reserves to a treatment plant located at Careys Gully

• Process Description

Sewage flows up to 4000 l/sec are pumped to the plant inlet works utilising 10 250kw submersible pumps. Following screening and grit removal in the inlet works, the flow passes through lamella plate separators, removing around 60% solids. Secondary treatment uses Kaldnes suspended carriers enabling us to develop a low profile, compact design. This is followed by the solids contact/reaeration process which ensures a high degree of process flexibility and robustness. The plant is within enclosed buildings with all the foul air removed via an odour control plant. The odorous gases are chemically scrubbed in three stages. Three secondary clarifiers - 42m in diameter - precede the final disinfection treatment carried out using ultra-violet light treatment. This reduces the final faecal coliform count to less than 200 fc/100ml.

• Conclusion

The DBO (design, build and operate) structure of the contract - known as Clearwater Wellington - brings significant advantages to the client. Risks are transferred from the Council to the contractor, and there are performance guarantees in place. The council retains ownership of the asset, while AWI is responsible for operating the plant to the prescribed standards during a 21-year period. The contractor has a natural incentive to design and build an efficient, high quality works to deliver optimum lifetime cost. Anglian Water has arranged project financing for the construction in conjunction with Wellington City Council through bonds sold to institutional investors.

CASE STUDY: Avlon Wastewater Treatment Plant

- **Client :** AstraZeneca
- **Capacity :** 2500 m^3/day
- **Contract Value :** £19.4 Million
- **Scope :** Design, supply, erection and commissioning
- **Contract Completion :** March 2006

• General

This scheme provides full preliminary and secondary treatment for wastewater arising from pharmaceutical production at the Avlon works, together with sludge treatment facilities

- Flows up to 3000 m^3/d are treated through the plant and discharged via the existing outfall to the Severn Estuary
- Final effluent meets a treatment standard of 80% removal of soluble COD or 500 mg/l soluble COD, whichever is the greater, subject to a 50% reactor fill of Anox media and a minimum influent concentration of 1000mg/l
- Treated sludge is exported from the site as sludge cake, for final disposal by incineration
- Doosan Enpure took on the role of CDM Planning Supervisor and Principal Contractor and were also the designer for all process, mechanical, electrical & systems engineering
- Civil and building services work was undertaken by Alfred McAlpine Civil Engineering, utilising Pell Frischmann as designers and Stride Treglown as Architect

• Process Description

Preliminary treatment: consist of :

- Coarse solids separation
- Blending and balancing
- Nutrient addition and pH balancing

Secondary Treatment consist of :

- Biological treatment utilizing Anox suspended carrier aeration process in two parallel reactor streams each comprising three reactor tanks
- Storage of final effluent during periods of low tide

Sludge Treatment consist of :

- Treatment to remove and thicken sludge produced in preliminary and secondary treatment and to convey to skips for removal from site

• Conclusion

The client successfully took over the Avlon Effluent treatment plant on March 2nd, 2006. This scheme was a complex and high quality plant, working for a client who quite rightly required the very best standard of work.

CASE STUDY: Ringsend Sludge Treatment Plant Extension

- **Client :** CAW for Dublin City Council
- **Capacity :** 120t(Dry solid)/d
- **Contract Value :** €20 Million
- **Scope :** Extension of existing sludge plant, including a third stream CAMBI THP process. SAS Drum Thickeners, sludge thickening centrifuge, 4th Digester tank, SCADA and MCCs
- **Contract Completion :** October 2009

• General

As part of Dublin City Council's program to upgrade the Ringsend wastewater treatment plant, CAW the plant operator and Doosan Enpure were employed to provide the following services: Design, Procurement, Installation, Commissioning and Operation of an Extended Sludge Plant incorporated a new third stream CAMBI THP Sludge Plant.

The scope of work for this extension included the provision of:
- Additional SAS Drum Thickeners with associated plant
- Additional sludge thickening centrifuge with associated plant
- Third stream of CAMBI THP Plant including four reactors to handle an additional 56 TDS/day of thickened sludge with associated plant and additional steam generation capacity
- Additional 4th Digester Tank of 4,500m^3 capacity, 1:1 aspect ratio with internal draft tube mixers in upward flow mode
- Digester sludge cooling / recirculation systems
- Associated instrumentation, electrical cabling, SCADA control and MCC's

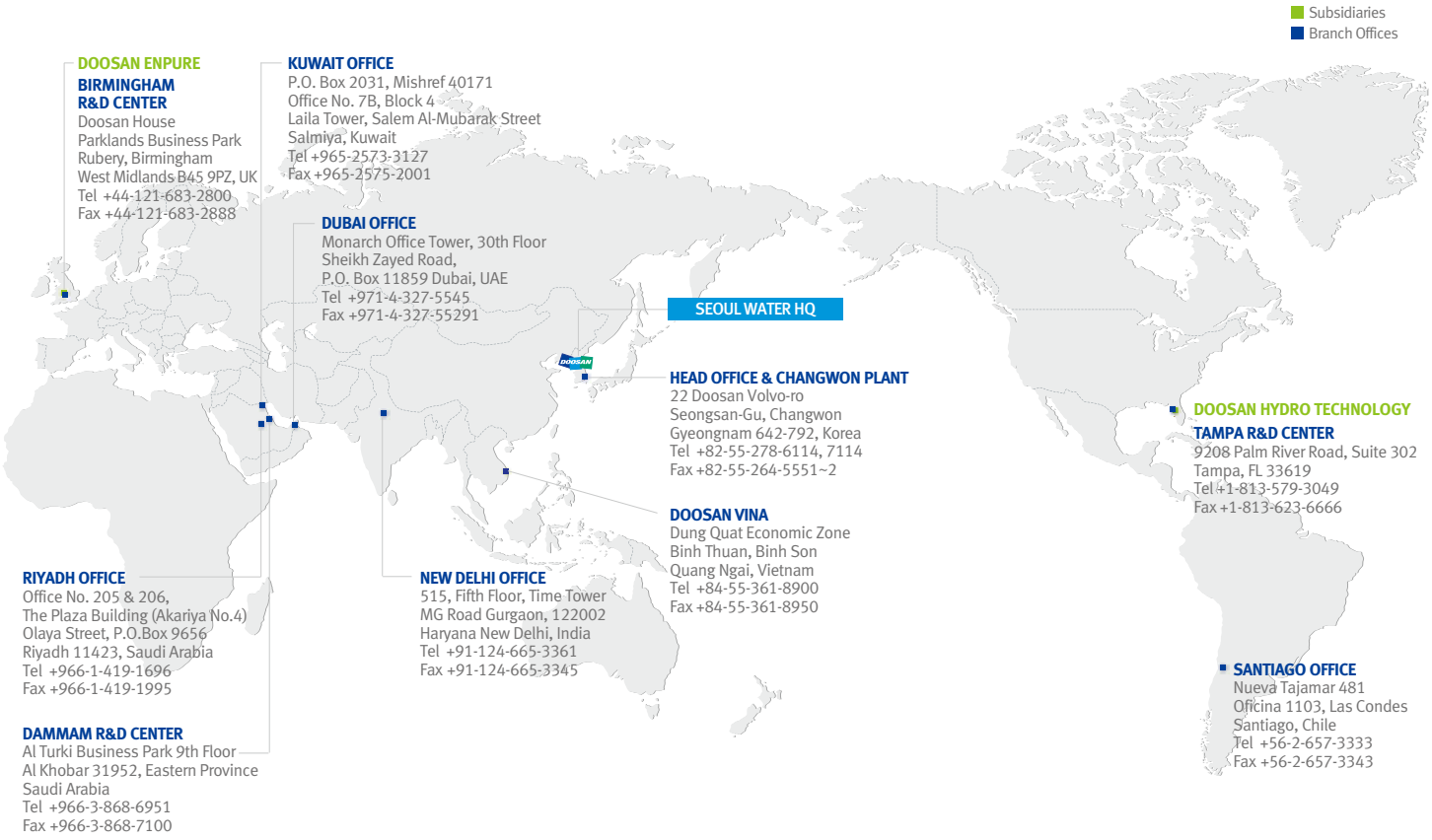
• Process Description

The original Cambi 8-reactor THP plant was designed to treat 36,000 tons DS sewage sludge annually, which was after treatment digested and then dewatered and dried. The wastewater treatment plant was originally operating a two-train drum drying system of the raw primary sludge to meet the requirements of pasteurization in Ireland. The plant was extended by adding SBR biological secondary treatment reactors to the existing primary treatment plant, doubling the sludge quantity. However, by adding Cambi THP the digested cake volume was reduced and the dryer project was only expanded by 50% to cope. Also, the required digestion volume was reduced: Three 4,500 m^3 digesters are fed at about 6 kg VS/m^3/day and routinely achieve 60% VS conversion with 45,000 m^3 per day of biogas. The sludge plant has been extended to achieve an approximate 50% increase in capacity. To achieve this a new third CAMBI stream was added, consisting of a 4-reactor THP plant, designed to handle an additional 56 TDS/day of thickened sewage sludge. Additional equipment has also being added to the plant to accommodate the additional sludge throughput including:- three new SAS drum thickeners (making 6 in total), one new pre-THP thickening centrifuge (making 3 in total) one new 4,500m^3 sludge digester tank (making 4 in total) and four new digester cooling / recycle systems. To accommodate the new third stream of THP plant and the new centrifuge installation, obsolete plant had to be removed from the existing building including two belt thickener / press units, conveyors and support steelwork; redundant odour plant and the compressed air installation had to be relocated.

• Conclusion

The introduction phase of the new plant was completed on time and to budget. The contract was conducted in an open manner with full cooperation and contributions to team solutions by all stakeholders.

WATER NETWORK



CORPORATE NETWORK

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Tampa, USA

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Crawley, UK

DOOSAN POWER SYSTEMS INDIA
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