MBR application for the JET-LOOP SYSTEM:

Case study and future trends.

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The JET-LOOP SYSTEM:

The technology – Advanced Aeration System.

The Jet-Loop System is a high-performance compact bio-reactor featuring a powerful Primary and Secondary wastewater treatment for both sewage and industrial wastewater.
The JET-LOOP SYSTEM:

Brief history – Development and commercial applications.

1996-1999: Jet-Loop System development supported by European Commission – LIFE 96 Program project research.
1999-2001: First commercial applications In Europe
2004-2005: First JET-LOOP SYSTEM <>MBR project.
2006: First Middle East project
2010: First USA – Russia project.
2011: First China project.
Development and first commercial applications.

18 L prototype. National institute of Technology _ Lisbon-Portugal 1997

3D Process Engineering 1998

Industrial Application Coop. Industrial Trevões. Portugal 1999
European first commercial projects (2000-2007):
European first JET-LOOP SYSTEM <>MBR project:

2004-2005: industrial wastewater treatment and reuse

UF hollow fiber membrane modules for final tertiary treatment and water reuse in agriculture irrigation.
The JET-LOOP SYSTEM:

MAIN INTERNATIONAL PROJECTS

2006 – first international project: Coca-Cola factory, Ryhiud – Saudi Arabia

2007 – 13 large sewage treatment plants for Baghdad, Iraq.

JET-LOOP SYSTEM Commercial applications.

2007 – 13 large sewage treatment plants for Baghdad, Iraq.
Total Capacity: 165,000 m3/day
JET-LOOP SYSTEM:
Commercial applications.

Capacity: 10,000 m³/day.
**JET-LOOP SYSTEM - The Aeration Innovative Process.**

Innovative aeration: no compressors, no blowers, no aerators, no diffusers; just water flow motion as the driving energy for a powerful aeration. The Jet-Loop System advanced aeration process can deliver more than 4,6 kg Oxygen / KW.

Comparative aeration efficiency chart for existing conventional aeration processes show that the Jet-Loop System can lower power consumption in aeration by more than 75% if comparing with most aeration devices actually being used.
Typical Ranges of Oxygen Transfer Capabilities For different aeration equipment

- **Fine Bubble Diffuser**
- **Coarse Bubble Diffuser**
- **Surface Low Speed Aerator**
- **Submerged Impeller**
- **Surface Brush And Blade**
- **Jet Loop Ejector**

Kg O2/KWh
**JET-LOOP SYSTEM - The Aeration Innovative Process.**

In terms of mechanical reliability and maintenance costs, the Jet-Loop System is also a better option, derived from its practically zero maintenance costs. This advantage results from the fact that the Jet-Loop System aeration process doesn't include any mechanical moving parts, except the circulation centrifugal pump.

We have been reported installations in operation in Europe since 2005, without any noticeable maintenance costs involved.
Jet-Loop System: how it works.

The Jet-Loop System aeration is able to inject up to 5-6 m³ air per m³ water wastewater circulated.

The circulated wastewater is thus used as a powerful driving force able to suck-inject air into the liquid in a completely new way; by taking the advantage of the use deep tanks (7-12 m depth) and the fact that the air double cross the total depth of the wastewater level.
How does the JET-LOOP SYSTEM aeration works?
Jet-Loop System: outstanding capacities in numbers:

Air flow-water ratio: 5-6 m³ air/m³ wastewater in circulation.

Standard Oxygen Transfer Rate (SOTR): 4-4.6 Kg O₂/KW

Standard Oxygen Transfer Efficiency (SOTE): 63.8%

COD load: 1-7 Kg COD/m³.day

Air Holdup Volume: 6.6% of total aeration designed volume.
  Kla effective: 0.33 min⁻¹

DO in industrial wastewater and sewage: 40%-60% DO saturation.
Jet-Loop System<>MBR combined:

The Jet-Loop System is the perfect combination for MBR processes. The modern MBR processes uses UF submerged membranes. For a good operation, the membranes should be sufficiently aerated for:

a) Keep a good oxygen supply to the process in order to sustain one of the best MBR advantages - the capacity to operate with high MLSS (biomass concentration) - and thus allow for a very high Feed-Mass (F/M) ratio.

b) Keep a good cleaning capacity of the membranes surfaces, preventing clogging with biomass buildup in the spaces between the UF filtration interfaces.
Jet-Loop System <> MBR requirements:

The oxygen supply in conventional wastewater treatment processes is a high limiting step, the real bottleneck for the whole wastewater depollution process.

The need for extra aeration is perfectly understand by the stoichiometric requirements to bio-oxidize the organic matter load to any aerated process; In this way, when increasing COD specific loads and increasing MLSS concentrations, the DO levels should be able to be sustained by a reliable and cost effective aeration solution.
Jet-Loop System <> MBR requirements:

The UF membranes clogging is another important factor to address in MBR solutions.

In different forms to apply UF – hollow fiber in IN-OUT filtration, hollow fiber in submerged processes operating OUT-IN and flat sheet submerged membranes, the clogging is a limiting handicap to good performance and can compromise the process.

The MBRs require additional forms of preventing the clocking of the membranes by good air and water agitation, and the JET-LOOP SYSTEM can provide it without additional energy costs.
Jet-Loop System <> MBR in China:

JET-LOOP SYSTEM <> with MBR flat sheet submerged membranes have been tested in a pharmaceutical wastewater project, in TaiZhou-Zhejiang Province.

The preliminary experimental use of MBR show that it will be able to:
1- Reduce the required volume for the activated sludge treatment from a conventional SBR with more than 8 days HRT to a MBR with less then 2 days HRT.
2- increase the biomass concentration to operate from the usual 2000-3000 mg/L MLSS to be increased up to 12000-18000 mg/L in the MBR
3- The treated COD efficiency was observed to lower from 700-800 mg/L with conventional SBR system to less then 400 mg/l with the MBR.
Jet-Loop System <> MBR in China:

The MBR prototype has been in continuous operation since February 2011, for reliability and performance data confirmation.

MBR (submerged flat sheet membranes) prototype with permeate extraction system.

Raw wastewater and treated water.
Jet-Loop System <> MBR in China:

JET-LOOP SYSTEM <> with MBR flat sheet submerged membranes have been tested in a pharmaceutical wastewater project, in TaiZhou-Zhejiang Province.
Jet-Loop System <> MBR in China:

The project using the JET-LOOP SYSTEM <> MBR will be completed in July 2011 (first phase for 400 m3/day capacity) and will be extended to 800 m3/day during 2012.

The use of the combined JET-LOOP SYSTEM <> MBR is expected to result in a CAPEX cost savings of 3 million RMB in a total initial investment of 8 million RMB.

The OPEX savings in energy will achieve 35-45% in comparison with the previous SBR conventional solution.
Jet-Loop System <> MBR summary

The JET-LOOP SYSTEM <> MBR show an unique capacity to:

1- Maintain high DO levels even with high MLSS. DO>4 ppm O2
2- Provide enough aeration and cleaning to MBR membranes. 0,5-0,75 m3/h /m2 membrane.
3- Eliminate the needs for the use of secondary clarifiers.
4- Improve dramatically final water quality. NTU<1.
5- Eliminate the use of sludge thickeners. MLSS> 12000 mg/L
6- Provide the right conditions for water reuse. Ready for NF and RO.
7- Reduce CAPEX and OPEX costs. Less investment, less operation & maintenance costs.
Jet-Loop System <> MBR future trends.

The JET-LOOP SYSTEM <> MBR can apply to sewage and industrial wastewater with the total flexibility provided by the enumerated unique combined advantages.

For the future the JET-LOOP SYSTEM <> MBR can be expected to become the Number One technology due to the additional facts that the construction can be done in short time, as a modular- prefabricated form.

Furthermore, the operation is very simple and maintenance practically free. The membranes actual life span are extended to 5 years and its expected that this life span will keep increasing to 7-10 years, as long as the membranes materials and standard fabrication will improve and the operation conditions will be better monitored.