The MIXFLO® system was designed by SIAD in order to transfer, with high efficiency, a gas into a liquid - such as pure oxygen into a mixed liquor - and homogenize its concentration in the reaction basin.

The need for a system able to solubilize pure oxygen into a mixed liquor came out in the early 80’s, when SIAD wanted to find a solution to the limitations, often met during winter time, in the aerobic stabilization process of the waste sludge produced in waste water treatment plants. As all reactions, the biological ones are affected by the thermal level obtained in the process and, in case of aerobic sludge digestion, the kinetic phenomena change sensibly in the range of temperature between 10 and 40 °C.

In wintertime, the sludge aerobic digestion process operates at low biokinetic velocity, due to the low thermal level obtained in the reactor. The idea of “heating”, indirectly, the biological reactor came to us from the observation of the negative influence linked to the large amount of air emitted in the atmosphere from the oxidation ditches. In fact, the air dissolution systems showed, and still show, low transfer efficiency and consequently require the injection, in the mixed liquor or in the thickened sludge, of large amounts of air to obtain the dissolution of the requested oxygen quantities. For example, with a transfer efficiency of 10%, 43 kg of air must be injected in the liquid phase in order to dissolve only 1 kg of oxygen. Such a large amount of air generates two contemporaneous phenomena:

- the formation of harmful aerosols containing the organic substances present in the mixed liquor or in the sludge
- the reduction of the temperature in the liquid processed.

The water vapor removal, in relation with its partial pressure, from the basin surface represents a constant removal of energy due to the liquid necessity to reach thermodynamic equilibrium with the ambient, generating a new vapor phase whose formation happens at the expense of a thermal energy loss in the system. Avoiding such a water vapor removal from the surface, the thermal dispersion cause is reduced and it is possible to operate as in an “insulated” system.

From these observations our goal was to design a system able to:

- transfer homogeneously and efficiently the oxygen needed by the biological process;
- heavily reduce the gaseous emissions into the atmosphere, working as in an “insulated” system, in the absence of aerosols;

We designed and patented our MIXFLO® system.
How the MIXFLO® system is realized

The MIXFLO® system is realized by:

- a centrifugal pump that sucks mixed liquor, or in general liquid, from a reaction basin and pressurizes it to a pressure comprised between 2 and 3 barg;
- a tubular dissolutor to dissolve (the oxygen) completely and obtain a monophase;
- a series of liquid-liquid ejectors to re-inject, in a homogeneous phase, oxygen and energy in the oxidation basin to be completely mixed.

The choice of pressurizing the mixed liquor to be recirculated is linked to the higher capacity of gas solubilization into a liquid by increasing its pressure (Henry's Law). This permits to obtain a liquid flow with high oxygen dissolved and therefore having a “rich solution” in oxygen to be mixed with a low oxygen dissolved liquid. The tubular dissolutor has been designed to obtain a homogeneous dissolution of the gaseous oxygen into the liquid, using as driving force the kinetic energy of the liquid itself, and produces a monophase before the ejector nozzle. Our liquid-liquid ejectors are the heart of the system. They are designed in order to suck in the ejector throat a defined amount of mixed liquor, and mix, under pressure, the oxygen rich phase with the poor one obtaining a new homogeneous and stable mixture.

This is the scientific base of our MIXFLO® system whose efficiency is proved by the large number of units nowadays active throughout the world.
The reasons to use pure oxygen in biological waste water treatment plants

The active part of the biomass, as sludge flocs in the biological oxidation basin, needs oxygen to conduct the synthesis reactions. Therefore oxygen may become a limiting factor for the biological process if it is not supplied in the adequate quantity. The oxygen diffusion, inside the sludge floc, is linked to its concentration in the mixed liquor and therefore high concentrations of dissolved oxygen produce more active biomass, able to remove higher quantity of dissolved organic matter.

This is the reason the MIXFLO® system enables to manage noticeable variations of the organic load, in biological WWTP, and makes the biomass more rapid to adapt to waste water pollutants variations. The MIXFLO® system offers rapid adjustment of the oxygen concentration in WWTP and its flexibility is of great advantage for all the industry having a seasonal productive cycle.

In the industrial WWTP the advantages of reducing the pollution due to aerosols and noise is not less important than the flexibility in operating the plants and capacity increase of waste water treatment. The versatility of the MIXFLO® system is exalted, in the industry, by the frequent presence of tanks, not in use, for waste water accumulation or settling, that may be transformed in biological oxidation basins in an easy and economical way. The MIXFLO® system makes it possible to treat waste water coming from septic tanks in specific reactors.

Its capacity of adapting to high pollutant concentrations and the absolute absence of smells and aerosols makes attainable the water treatment in compact units without polluting the environment.

Flexibility and operativity of the MIXFLO® system

Pure oxygen is automatically fed to the MIXFLO® system, measuring the dissolved oxygen in the biological oxidation basin. In this way, the oxygen consumption is optimized and fed only when needed.

The pump-ejector system assures the perfect mixing of the biological reactor. It is possible to increase the dissolved oxygen level in the basin to a value higher than the usual 2 to 3 mg/l, up to values of 10 to 20 mg/l, without any reduction in the oxygen dissolution efficiency, even if it is designed to operate at a lower dissolved oxygen condition.

For example, we designed a tertiary nitrification reactor using the MBBR technology joined to a MIXFLO® system that was studied to operate with a dissolved oxygen level of 10 to 15 mg/l.
SIAD S.p.A. is a leading company producing industrial gases, oxygen, nitrogen, carbon dioxide and specialty gases, in Europe. Moreover, with our SIAD Machinery and Plants, we can build air separation units for in-situ oxygen generation.

SIAD has a group of specialists devoted to the development of specific technical solutions customized for client industrial processes. Recent realizations of biological WWTP, fed with in-situ oxygen production, give our Company high competence in the technological sector of waste water treatment.

Among recent innovative technologies for waste treatment we offer not only the technology to use pure oxygen, but also design upgrading and retrofitting of your plants with the MBBR (Moving Bed Biofilm Reactor) technology.

Our Company has the license, for the Italian market, of such a technology, developed and patented in Norway by Kaldnes, using carriers to support very active biomass. Specialized and highly active biomass attaches to the carriers turning the classical waste water treatment plants in to high flexible units with high oxygen transfer requirement.

The merging of Moving Bed Biofilm Reactor and our MIXFLO® system brings about a new technological development scenario: the future of pure oxygen fed with specialized biomass biological waste water treatment plants.

What other services we offer together with the MIXFLO® system

Usually we employ the MIXFLO® system to dissolve carbon dioxide, for pH control of alkaline effluents, or to solubilize ozone for chemical oxidation in disinfection processes and in the surfactants and colors removal.

The MIXFLO® system has been designed to dissolve all gases

**Fig. 1**
ASTRA AB (SVEZIA)
Pharmaceutical production

**Fig. 2**
PHILLIPS PETROLEUM (USA)
Refinery

**Fig. 3**
LILLEHAMMER (NORVEGIA)
Domestic waste water treatment

**Fig. 4**
KALDNESS MOVING BED patent biofilm reactor process

**Fig. 5**
OSLO
Domestic waste water treatment

**Fig. 6**
BAS: Bergamo Ambiente Servizi
Tertiary nitrification