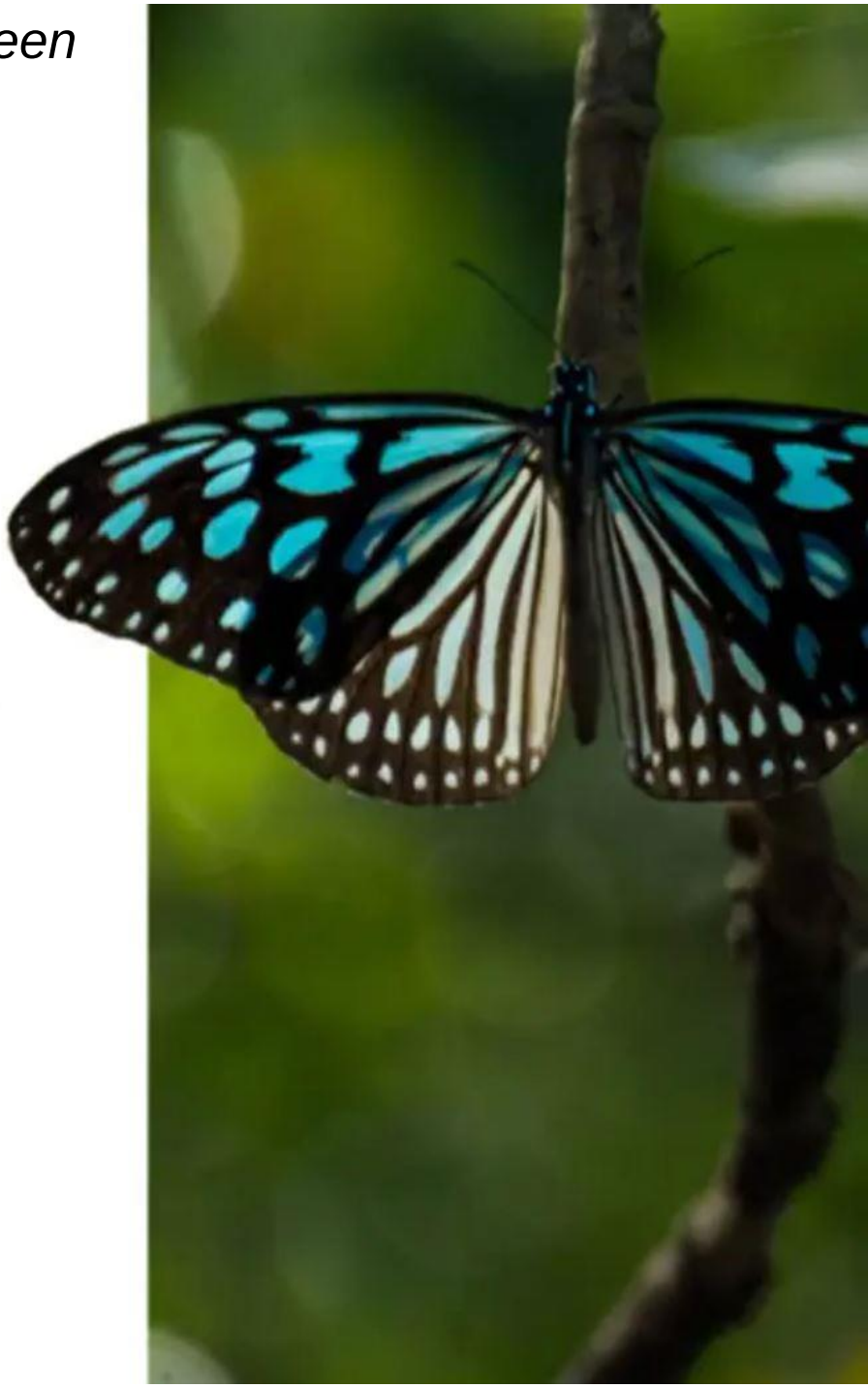
Comparison between the technologies :

IFAS and NIFAS®



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How does IFAS work ?
Integrated fixed film activated sludge (IFAS) is an innovative wastewater treatment technology that offers several advantages over conventional activated sludge technologies. IFAS involves adding an attached growth media to an activated sludge tank to facilitate biomass growth and strengthen the treatment process. The media added may be either fixed or free-floating. An IFAS system can be installed as an upgrade to an existing facility or as a new construction.
This setup results in two different biological populations that act synergistically. The mixed liquor suspended solids (MLSS) degrade the majority of the organic load, and the biofilm establishes a strong nitrifying population that enables the oxidation of the nitrogenous load. Biofilm processes enable the anaerobic, aerobic and anoxic zones to exist together in one stage, and IFAS systems enable the additional biological population to be on a fixed surface, which means it's no longer necessary to increase the suspended growth population.

Parts of an IFAS System
An IFAS system provides similar benefits to conventional activated sludge solutions while joining these technologies into a single reactor. While an IFAS system may vary in components, a typical configuration is similar to an activated sludge plant.
Within an IFAS system, biomass carriers are introduced to the system in select zones located within the activated sludge process, allowing two biological populations to work together. IFAS anaerobes and aerobes travel through a clarifier through the IFAS process. Whether or not an IFAS system is based on fixed or dispersed media, it requires proper preliminary treatment design, implementation and operation. Fine screening or primary clarification helps prevent material buildup and ragging on the media in the aeration basin and dispersed media clogging. IFAS operational activities need to be performed by educated, trained and skilled professionals.

Pros and Cons of IFAS
Some of the advantages of using IFAS include:

- Improved nitrification as compared to simple suspended growth systems due to combining the aerobic, anaerobic and anoxic zones and increasing the sludge retention time
- Faster restoration of system nitrification due to the large mass of nitrifiers on the fixed film
- Possible improvements and reduced variation in the Sludge Volume Index (SVI)
- Reduced production of sludge
- Enhanced denitrification processes
- Additional biomass to improve the performance of nitrifying plants and help non-nitrifying plants nitrify
- Resistance to organic and hydraulic shock loads
- High levels of efficiency for a large range of wastewater
- Increased capacity of activated sludge systems within the same tank volume

While an IFAS system is highly efficient, there are certain aspects of the system you should be aware of:

- Some systems have higher energy requirements, such as aeration and mixing to uniformly distribute free-floating media
- Because of its effectiveness and efficiency, there may be higher initial costs for construction and operation
- IFAS systems use advanced technology, often requiring specialized knowledge and expertise
- Replacement parts may need to be purchased online instead of locally

Operation and Maintenance of IFAS Systems
IFAS systems have complex, highly mechanized configurations. Properly operating these systems requires expertise, so a trained professional needs to operate them at all times. Proper maintenance also requires technical expertise. To prevent ragging and material buildup on the media and retaining screens, primary clarification or fine screening is necessary. If system parts need replacement, they will need to be ordered, as they are not typically available locally. **Power system maintenance is also essential, as the system will fail in the event of a power outage.**

NIFAS® technology versus IFAS.

Mr. Suru Nathwani, owner of Environmental Wastewater Solutions ltd, if later indicated as EWwS ltd, has worked for over 40 years in the construction of BioDisk units and has established a worldwide reputation on this product.
By studying IFAS technology, he modified the process by incorporating an activated sludge basin, but separated from the BioDisc units and upstream with spectacular results and a simple process that does not require any intervention and management of the part of the operator.
He calls it **NIFAS® (NON-INTEGRATED FIXED FILM ACTIVATED SLUDGE SYSTEM)**

There are fundamental and process performance differences between NIFAS® and IFAS.

NIFAS® stands for Non-Integrated Fixed Film Activated Sludge Process, while IFAS stands for Integrated Fixed Film Activated Sludge Process. This difference makes it possible to separate the two technologies. NIFAS® allows us to achieve different process goals, such as energy recovery and total nitrogen TN reduction. With IFAS, on the other hand, fixed film growth and suspension growth (activated sludge process) are in the same reactor, which limits the process objectives, such as TN reduction to be achieved unless other operations are introduced into the system.

NIFAS® and IFAS are totally different.

NIFAS® is much more advanced than IFAS.

For new installations, IFAS technology or MBBR should never be a first-choice process, as they are complicated to operate and require a lot of daily human intervention.

The requirements for IFAS to work are:

The exterior surface of the plastic material must be kept clean of any biomass growth. This is to prevent the plastic media from clogging and creating large media blocks that do not allow nitrification. To keep the surface of plastic media clean, they must be scrubbed aggressively to remove biomass from the exterior surface.
This removed biomass is difficult to settle in the clarifier and therefore most IFAS systems generally use the DAF system to separate solids from mixed liquors. The DAF system is energy intensive and requires a lot of maintenance. To facilitate this cleanliness of the exterior surface of the plastic supports, a lot of mixing air is necessary at all times, even if there is no organic load to treat.

The DO threshold required to maintain complete nitrification in the IFAS system is 4 to 5 mg/l. To maintain this high DO concentration, much more process air is required. THE COMBINATION OF MIXING AIR AND PROCESS AIR RESULTS IN VERY HIGH REQUIREMENTS AND HIGH ENERGY CONSUMPTION.

As IFAS is an integrated system, it will only be suitable for BOD_5 reduction and nitrification. It is not possible to reduce TN in the IFAS system. Reducing TN would require the additional operation of the reactor to remove nitrates.

The IFAS system must use membrane diffusers for aeration, as any other system, such as surface aerators, will damage the plastic support. This makes it difficult to use a surface mounted fine bubble aeration system, like the Triton, which will be simple and easy to use. Membrane diffusers should be replaced every 8 to 10 years. This is expensive and means systems are down for a few weeks. How can this be facilitated when wastewater arrives on the site every day?

The NIFAS® system keeps the two processes separate and facilitates the achievement of different process goals. The upstream NIFAS® compartment (reactor) allows the system to operate in anoxic mode for energy recovery, TN reduction and BOD_5 reduction. The NIFAS® compartment also acts as a flow attenuation chamber, meaning the aerobic process is stable and has consistent performance.

The total system size is optimized and with reduced nitrate content of the liquor with regards to the final settlement tank, solids separation in the is much better. All these advantages materialize in the WWTP at Le Bignon in France. Simply use a 1mm fine screen, NIFAS® compartment, BioDiscs and Final settlement tank. We will optimize NIFAS® and BioDisks to reduce TN.

There are many other operational issues that can make IFAS undesirable. The bottom line is that it's best to stick to a well-sized and designed AS process and use compressed air. Or use BioDiscs if the fixed film process is preferred for its simplicity and lower energy cost. Mixing air and plastic media is the worse of the two processes.

The company J-STEP SAS, based in France and equipment representative of EWwS ltd in France, Belgium and Algeria, has completed the sale of a first NIFAS® WWTP in France. This plant with a capacity of 800 PE is located in Le Bignon (44). With the operator SAUR we monitored this installation and obtained 4 24-hour results over a period of one year. Please find the results and treatment efficiencies we obtained:

Analysis 24h	8 Nov 2023 *)		η in %	22 May 2024		η in %	1 Aug 2024		η in %	16 Sept 2024		η in %
	Infeed	Outfeed		Infeed	Outfeed		Infeed	Outfeed		Infeed	Outfeed	
Flow m^3/d	247	243		235	210		110	100		74		
BOD_5	188	4,97	**97**	700	4,1	**99,4**	645	1,4	**99,8**	350	4,9	**98,6**
COD	465	38,3	**92**	1270	39	**96,9**	1520	33	**97,8**	1100	35	**96,8**
SST	264	13,5	**95**	420	12	**97,1**	500	9,6	**98**	370	3,2	**99,1**
TNK	31,6	9,3	**70,6**	65	2,1	**96,8**	71	2,4	**96,6**	85	3,2	**96,2**
$N\text{-}NH_4$	19,4	7,1	**63**	12,4	0,2	**98,4**	41	0,1	**99,7**	57	1,1	**98,0**
$N\text{-}NO_2$	0,05	0,46		0,28	0,28		0,18	0,44		0,094	0,159	
$N\text{-}NO_3$	0,05	0,93		0,65	1,6		0,2	3,6		0,3	2,52	
TN	31,8	10,7	**66**	65,93	3,98	**94**	71,39	6,44	**91**	83,39	5,88	**92,9**
TP	5,2	0,25	**95**	17,9	0,26	**98,5**	13,7	0,27	**98**	12,6	0,24	**98,1**
Load in PE	**774**			**2741**			**1182**			**432**		

*) Before on-site intervention by EWwS Ltd to reduce the feed volume to the BiolDisks on March 28, 2024, which improved the yields.

It can be noted that the results have not changed, despite a significant variation in organic and hydraulic loads during the year. The process is stable and adapts to the loads received without operator intervention. We do not use DO or REDOX probes and the simple rotation of the BioDisks, which have 40% of their surface in the wastewater, allows the biomass to be oxygenated with only 25% of the required energy in a comparable activated sludge reactor.

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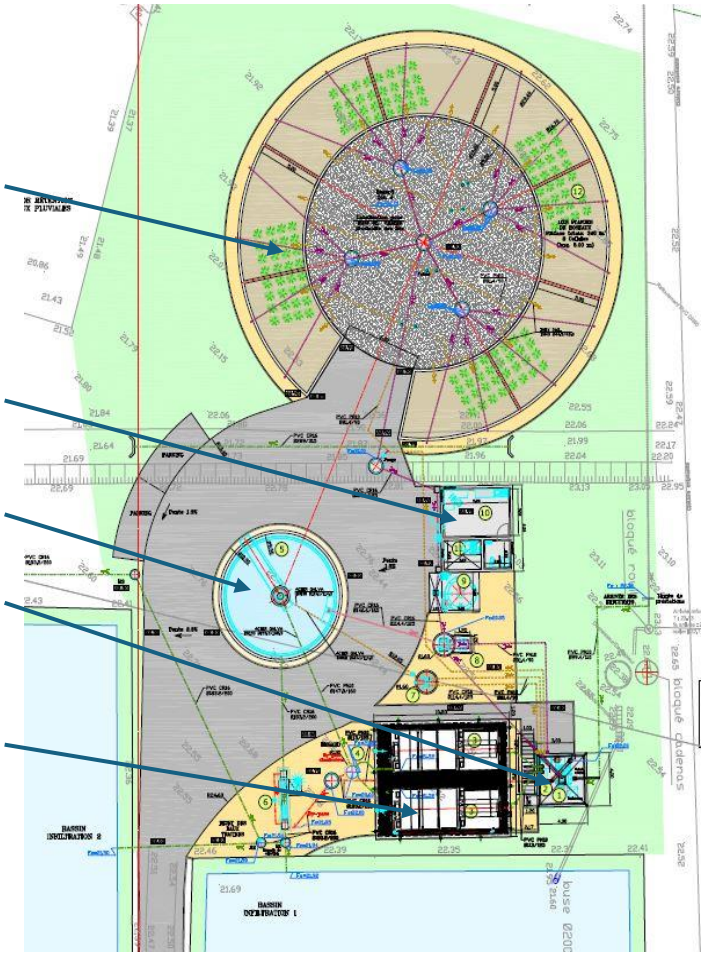
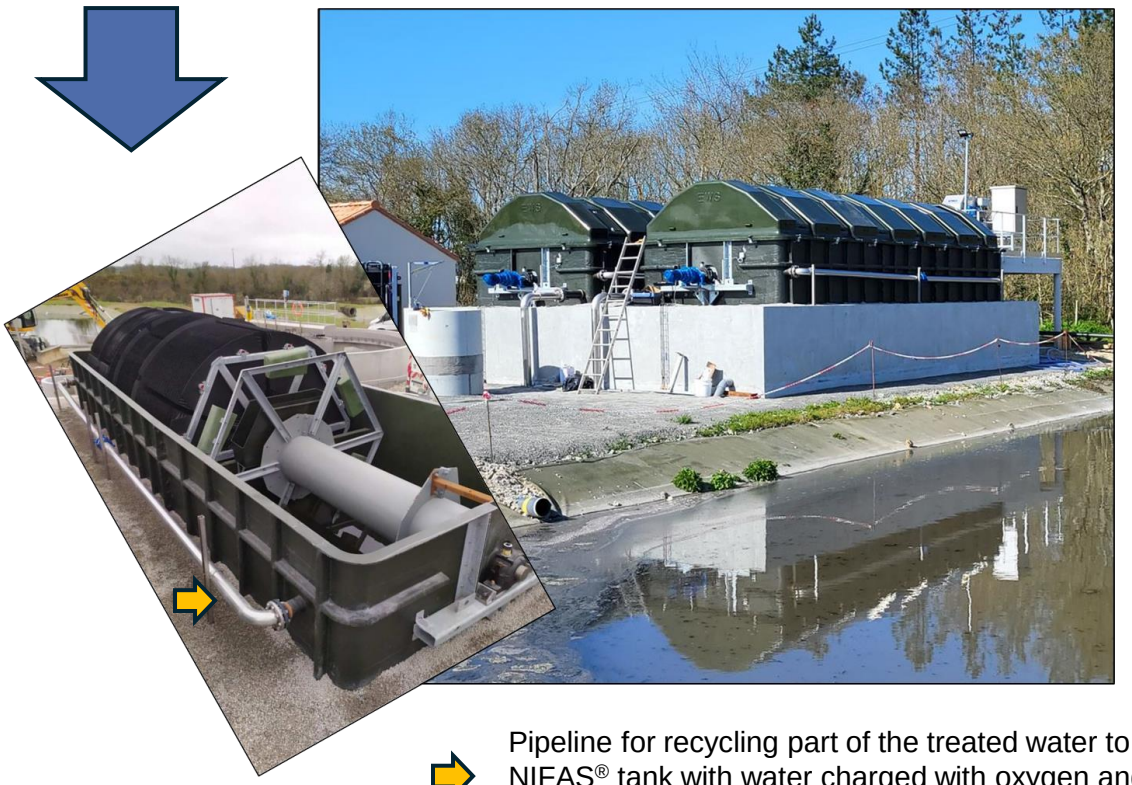
Layout of the WWTP in Le Bignon in France :

Please note that this plant is not equipped with a primary settlement tank and the flow attenuation is a self-regulating in-line type and incorporated into our unique NIFAS® tank design.

The only waste to be eliminated is the waste from the 2 mm rotary screen.



NIFAS® reactor with integrated flow attenuation stage, suspended solids mixing and bucket wheel for controlled water supply to the BioDisks.



Pipeline for recycling part of the treated water to the NIFAS® tank with water charged with oxygen and with biomass sludge at the exit of the BioDisks.