



# 20,000 m<sup>3</sup>/day cold weather BOD/COD removal and Nitrification MBBR/IFAS for Municipal Wastewater Treatment

## THE PROJECT - Cold Weather Nitrification

A City situated in the Northern Province of China has a population of 4.40.000 inhabitants. The city has severe winter weather during most of the time of the year. To reduce water pollution, the authorities have already planned construction of a 10000 m<sup>3</sup>/day Sewage wastewater treatment plant for the city's wastewater management. Originally the plant has been designed based on oxidation ditch pond variant of Activated sludge process to meet only BOD removal requirement for statutory compliance.

## THE PROBLEM

However, due to changes in legislation, the plant required to meet Chinese class I criteria of BOD, TSS, TN < 15 ppm, Ammonia < 5 ppm and COD, 50 ppm for compliance. Due to extreme cold weather conditions, achieving COD < 50 ppm and Ammonia < 5 ppm pose a significant challenge.

As it is well known fact that every degree C of decrease in liquid temperature reduces the biological activity and thus removal rates of activated sludge process. This reduction in the biological activity and removal kinetics of activated sludge required to double the volume of the existing aeration tank to compensate the treatment requirement as per the new standards.

## THE CHALLENGE: Cold Weather Nitrification of Municipal Wastewater

Due to inherent problems related to the cold weather conditions and space restrictions, the city was looking for a solution which can deliver the required results within the constraints with full utilization of already under construction plant.

Principle challenges associated with the project were:

- Very low liquid temperature (8-10 Degree C) during winter period resulting in lower biological activity of activated sludge
- Already plant was under construction and thus utilizing existing infrastructure and lack of further space availability were severe constraints
- Inlet load fluctuates a lot between spring and winter season due to specific water usage patterns which required to be treated to new stringent standards of BOD, TSS, TN < 15 ppm , Ammonia < 5 ppm and COD < 50 ppm under all conditions.

### **THE SOLUTION: LEVAPOR-IFAS Upgradation of existing Activated Sludge Plant**

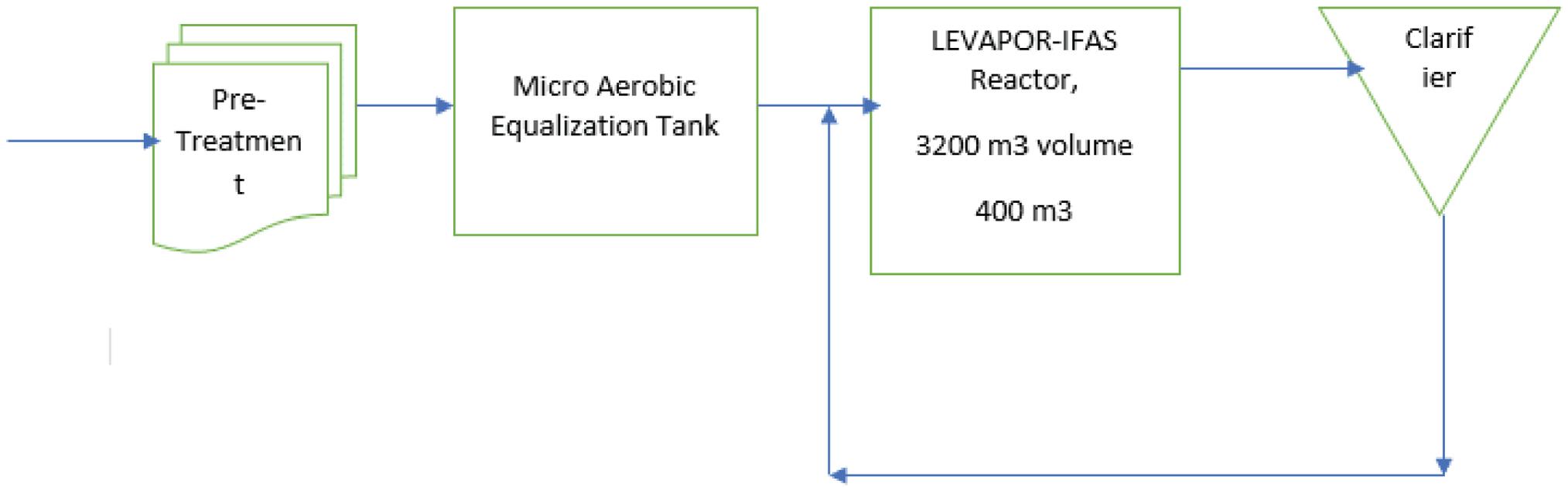
Due to our experience with cold weather nitrification of municipal sewage wastewater, a hybrid activated sludge based IFAS process using Levapor MBBR /IFAS media was suggested for the proposed modification of the plant.

After extensive trials at site, conducted under different scenarios of inlet wastewater conditions of temperature, BOD, COD, TSS and TKN, a design was implemented at site considering the existing aeration tanks under construction.

During the trials, it was found that even at a shorter HRT of 3.5-3.8 hours, the required results can be achieved for the plant and also inlet wastewater treatment capacity can be also doubled to 20-22 000 m<sup>3</sup>/day if required. Already the client was planning to construct another 10,000 m<sup>3</sup>/day plant for meeting full treatment requirement, it was decided to double the capacity also.

Based on the pilot trials and previous experience, following design for the proposed project was suggested.

<b>Design Parameter</b>	<b>Value</b>
Wastewater Flow	20-22000 m <sup>3</sup> /day
Inlet BOD	250-300 ppm
Inlet COD	550-700 ppm
Inlet TKN	25-65 ppm
Liquid Temperature	8-10 degree C Min
Hybrid IFAS Reactor Volume	3200 m <sup>3</sup>
HRT	3.5-3.8 hours
% Levapor Carriers filling	12.5%
Levapor carrier total quantity	400 m <sup>3</sup>



**Fig 1 : Process Flow Diagram of 20000 m<sup>3</sup>/day NINGAN Sewage Treatment plant**

## The Results

During October-2010, which is already winter in the city, the plant was commissioned after adding retention screens and 400 m<sup>3</sup> Levapor MBBR-IFAS media to the existing Aeration Tanks.



**Fig 2: Filling of Levapor MBBR IFAS media in the Aeration Tanks**



**Fig 3: Fluidized Levapor carriers in the reactor**

Despite low temperatures, the plant achieved COD reduction requirement within 2 weeks period and after 4-6 weeks period, stable nitrification was also established effectively achieving the required treatment goals as per Chinese Class I criteria.

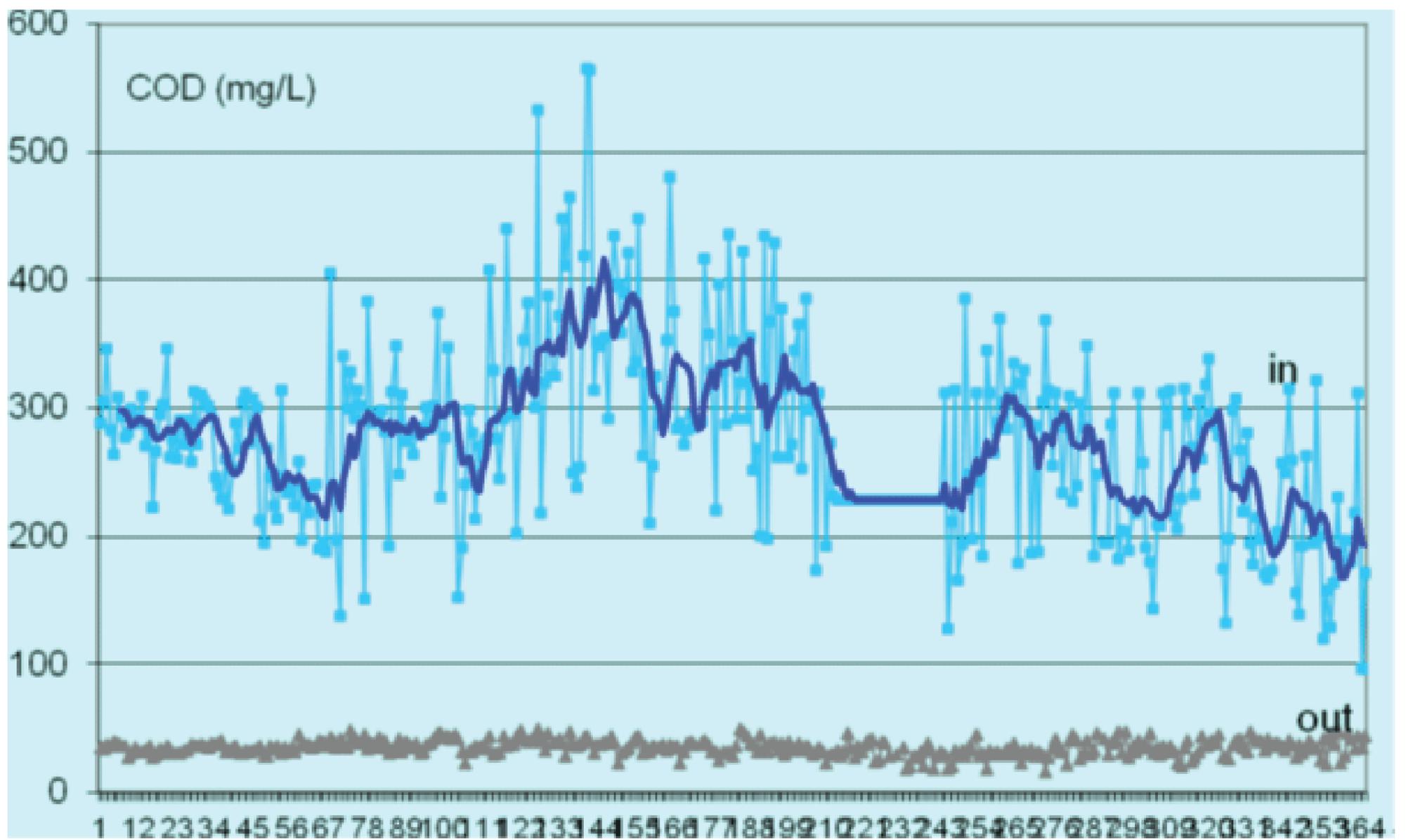


Fig 4: COD Removal Trend at the 20000 m<sup>3</sup> / day NINGAN Plant using Levapor IFAS process

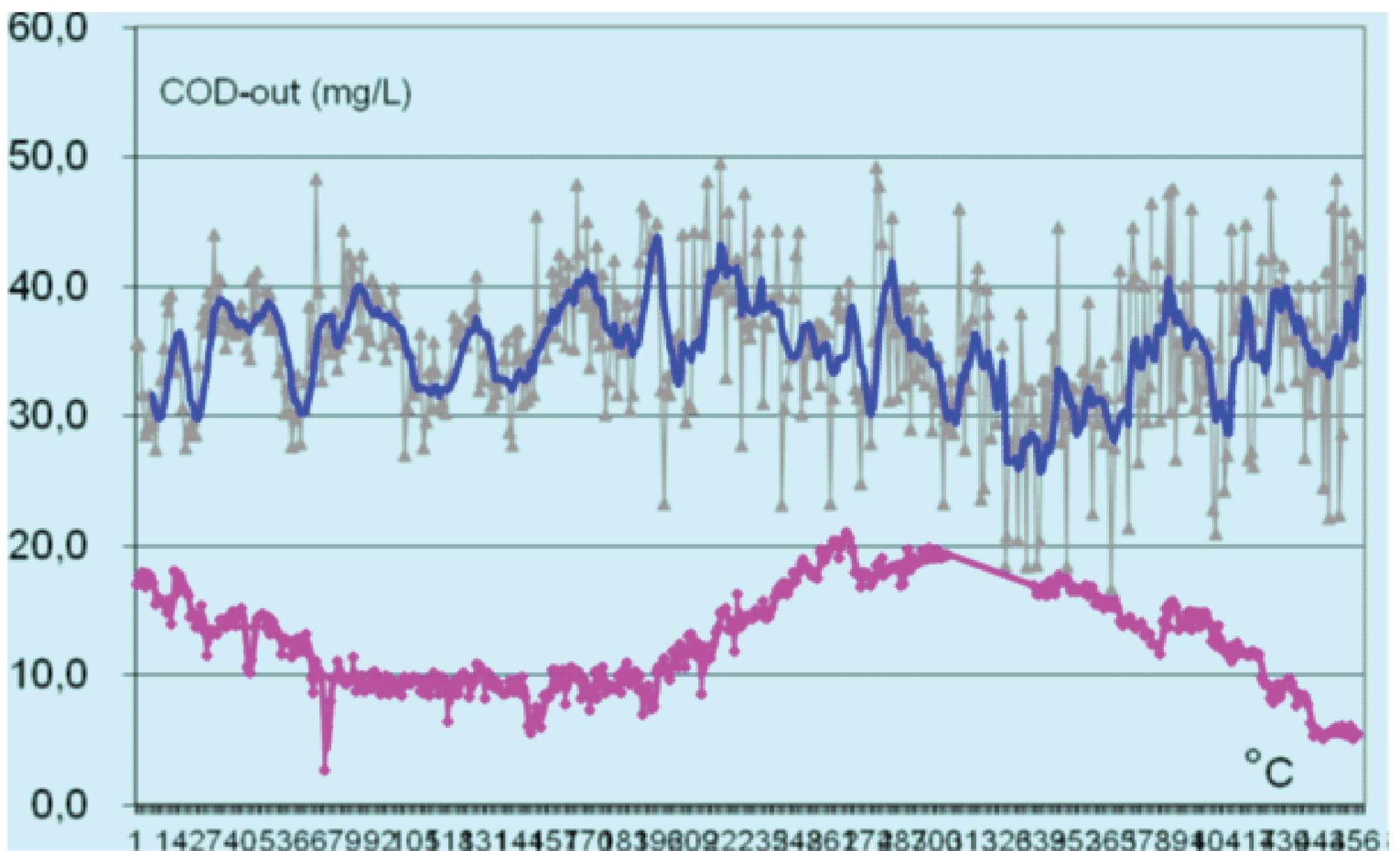


Fig 5: COD outlet versus Liquid Temperature at 20000 m<sup>3</sup> / day NINGAN plant using Levapor IFAS Process

Over the years of operation, the overall COD reduction at the plant has been stabilized to much higher level than conventional activated sludge process. Fig 4 and Fig 5 indicates the COD removal efficiencies and impact of temperature on the outlet COD values for the hybrid Levapor IFAS reactor. Despite fluctuations in the temperature as well as inlet COD, due to superior performance of the Levapor IFAS process, the plant is consistently achieving outlet COD < 50 ppm throughout the year.

### NITRIFICATION AND TKN REMOVAL:

Due to slow growing nature of nitrifying bacteria and their sensitivity to pH, Salinity, Temperature and certain pollutants, establishing nitrification process in any activated sludge is a challenging task for Biological Nutrient Removal (BNR) process.

However, due to its fine pore structure with presence of activated carbon, Levapor MBBR-IFAS media provide very high surface area and high inner porosity which provides ideal habitat for the nitrifying bacteria immobilization on the carrier surface in the biofilms.

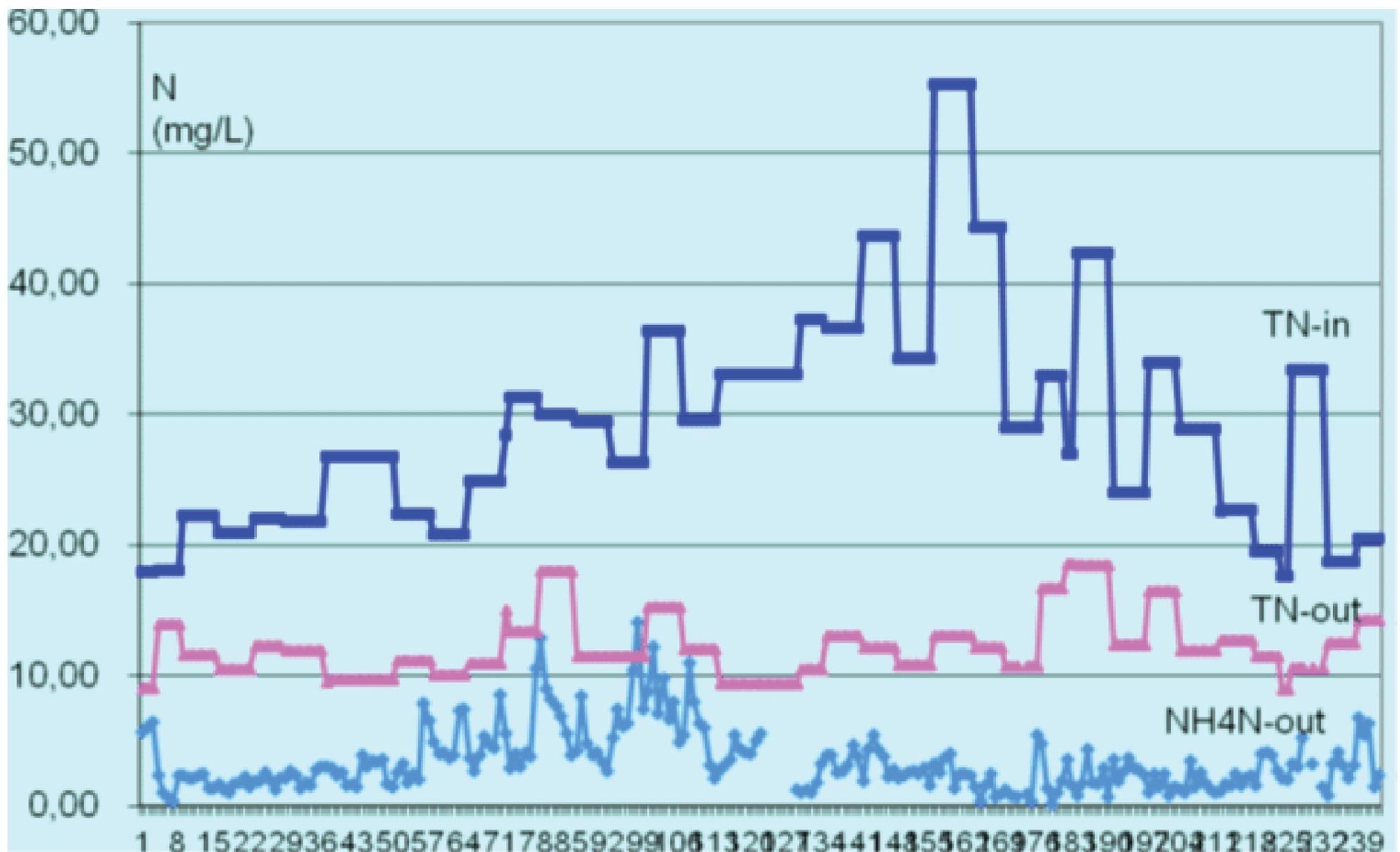


Fig 5: Ammonia /TKN removal trend at 20000 m3/day NINGAN plant based on Levapor IFAS Process

Fig 5, represent the nitrogen removal trends at the sewage treatment plant after addition of Levapor carriers in the reactor. Despite higher fluctuations in the inlet wastewater temperature and nitrogen load, the plant is achieving remarkable level of nitrification delivering required level of TN and Ammonia as per the Chinese class I criteria of Ammonia < 5 ppm and TN < 15 ppm.

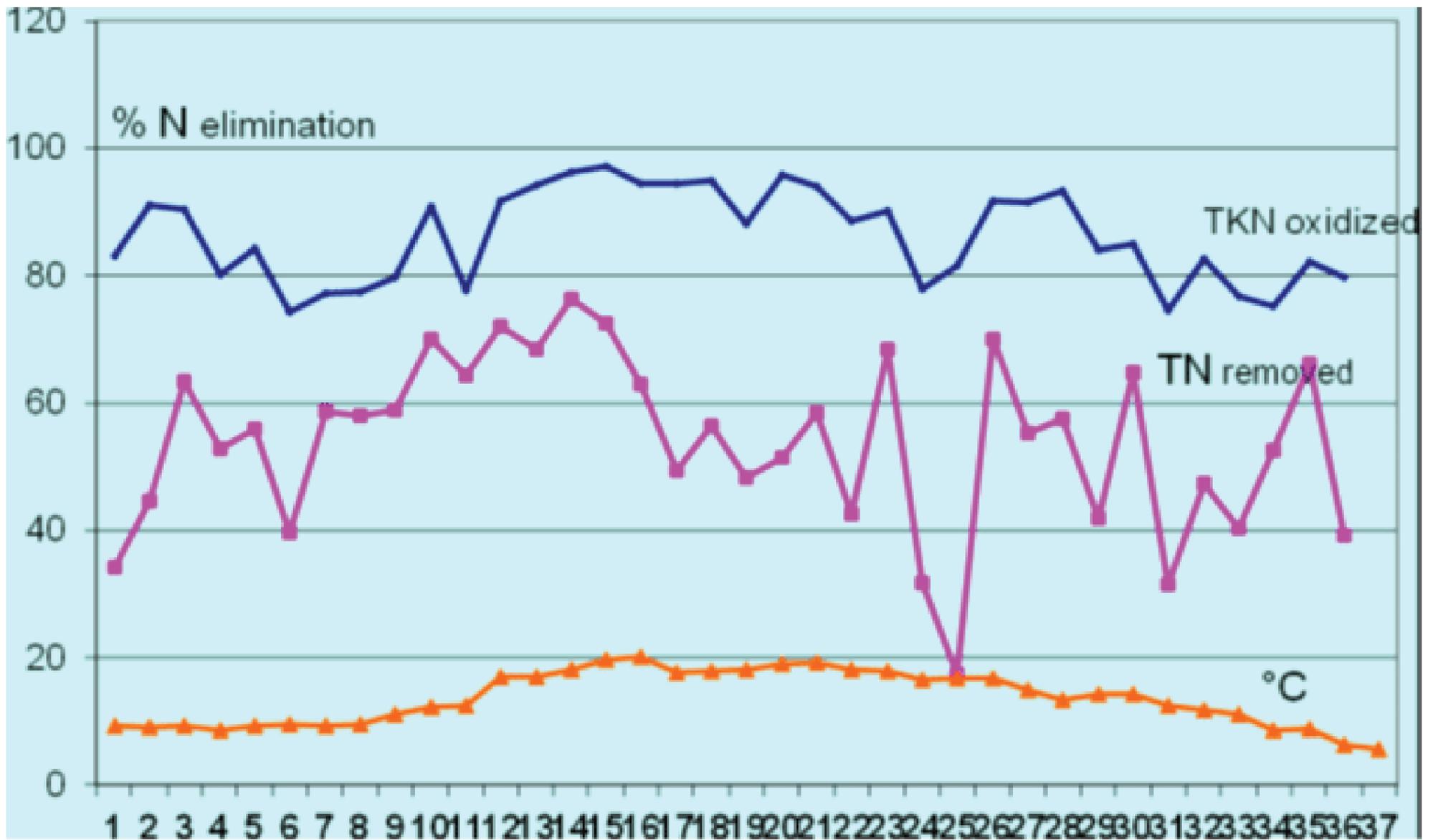


Fig 6: Nitrogen removal Trend against liquid temperature at 20000 m3/day NINGAN plant using Levapor IFAS Process.

### BENEFITS

- Despite lower retention time of 3.5 -3.8 hours , the plant is consistently achieving COD < 50 ppm , Ammonia < 5 ppm as per the clients requirement.
- Despite higher fluctuations in the inlet load, temperature, the plant is achieving required standard under all conditions.
- Plant capacity has been almost doubled and no further civil construction or space required for further expansion and upgradation of the existing set up

**LEVAPOR INDIA PVT. LTD.**

**BIOFILM-TECH GmbH**

414, Suncor Plaza, Nr. Jashoda Nagar BRTS, Next to Hotel Chatako, Jasoda Nagar, Ahmedabad -382445, Gujarat, India

25, Wilhelm street Bonn, D-53111 Germany