



Biodegradation of NMMO-containing Industrial Effluents using Novel Bacterial Isolate

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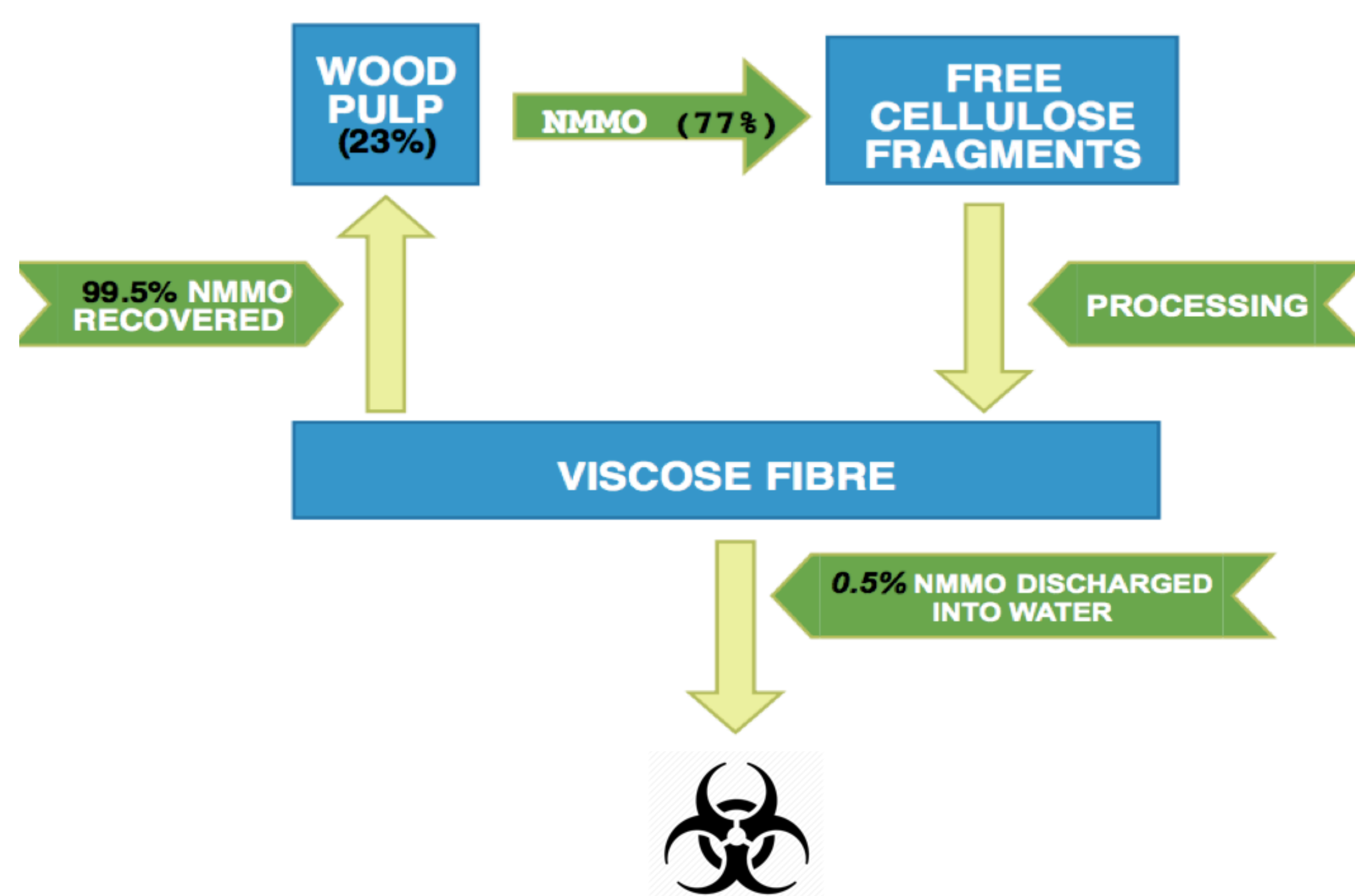
Objective

Reduction of COD values of textile effluents using bacterial isolate

Introduction

Today, there is intense scrutiny of the hazardous implications of industrial processes – with an aim to minimize damage to environmental resources. The viscose fibre industry uses N-methylmorpholine N-oxide (NMMO) to extract free cellulose from wood pulp, which is then processed to yield fibre. Despite efficient recovery of NMMO, a small percentage is discharged into river water – where it undergoes successive degradations to form morpholine. These organic species raise the Chemical Oxygen Demand of the water, which must fall within prescribed safety limits. In addition, the hazardous effects of morpholine on animal physiology are legion – effects include corneal oedema, liver and kidney failure, and respiratory disease. The need to counter this threat is therefore dire – and presents an opportunity for innovation.

Sequence Flow



Materials and Methods

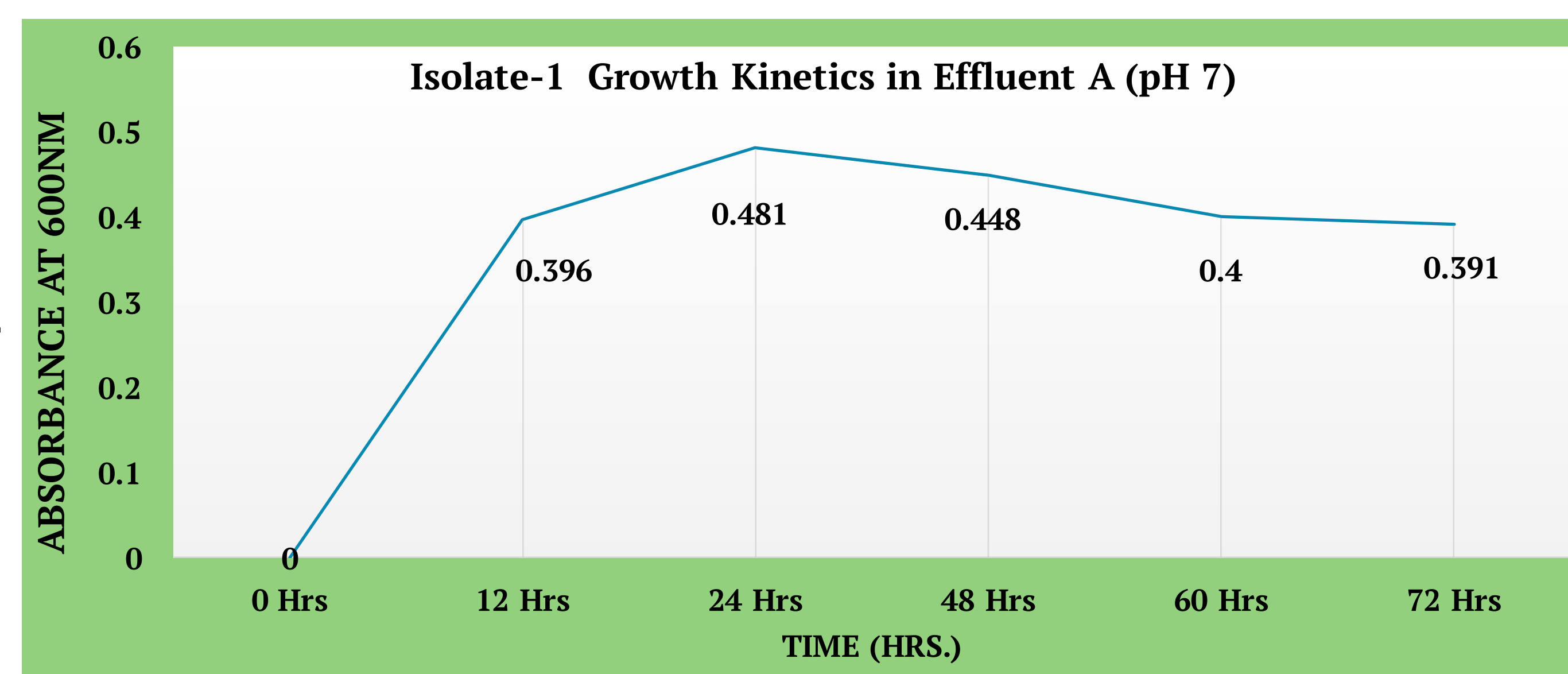
- Acquisition of bacterial isolates from soil and water samples at a West Bengal steel plant (morpholine alters pH of circulating fluids)
- Isolation of pure bacteria conducted by serial dilutions and pour plate method, characterization study and adaptation of culture to **0.15% morpholine**
- Acquisition of two effluent samples (hereafter known as A and B) from **viscose fiber industry**
- Verification of **presence of NMMO** and **absence of morpholine** by spectrophotometry and gas chromatography
- Initial study of pH and COD values of effluents, pH neutralization of acidic effluents, followed by dilution to 1:10 V/V
- Inoculation with bacterial isolate grown in enrichment media, followed by **48 hour incubation at 37° C** with shaking at 150 rpm.
- Optical Density readings taken as shown, and supernatant fluid from these samples stored for COD study.
- COD study carried out using Spectroquant TR320 (Merck) COD Digester at a temperature of 148° C for 2 hours.

Observations

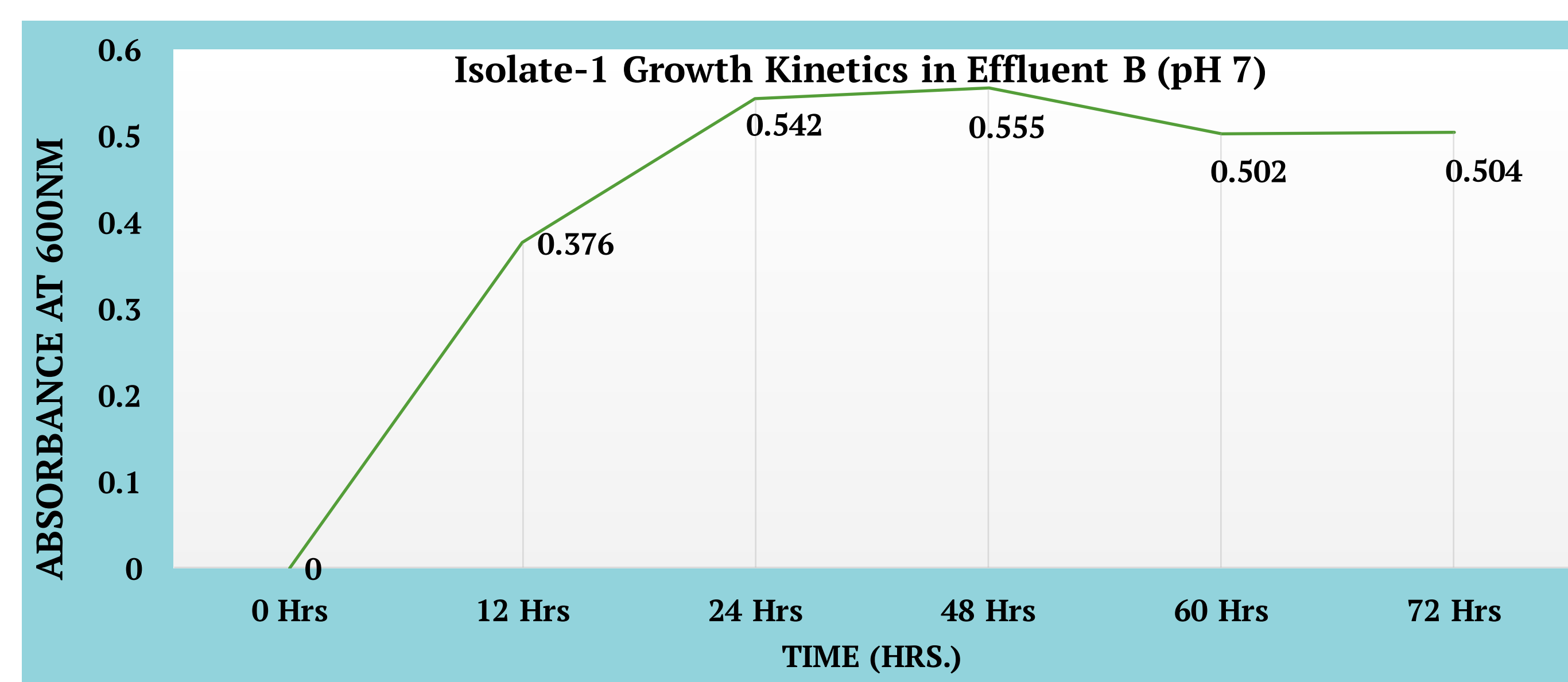
| Sample | Time (hrs) | A ₆₀₀ | Cell Density | COD Value | % COD Reduction |
|------------|------------|------------------|----------------------------|-----------|-----------------|
| Effluent A | 0 | - | - | 5640 | - |
| | 12 | 0.396 | 1.98X10 ⁸ cells | 4659.13 | 17.4 |
| | 24 | 0.550 | 2.75X10 ⁸ cells | 5333.48 | 5.44 |
| | 48 | 0.448 | 2.24X10 ⁸ cells | 4352.61 | 22.83 |
| Effluent B | 0 | - | - | 2640 | - |
| | 12 | 0.376 | 1.88X10 ⁸ cells | 2516.25 | 4.69 |
| | 24 | 0.542 | 2.71X10 ⁸ cells | 2392.5 | 9.38 |
| | 48 | 0.555 | 2.78X10 ⁸ cells | 2186.25 | 17.19 |

Growth Kinetics of Isolate in Effluent Solutions

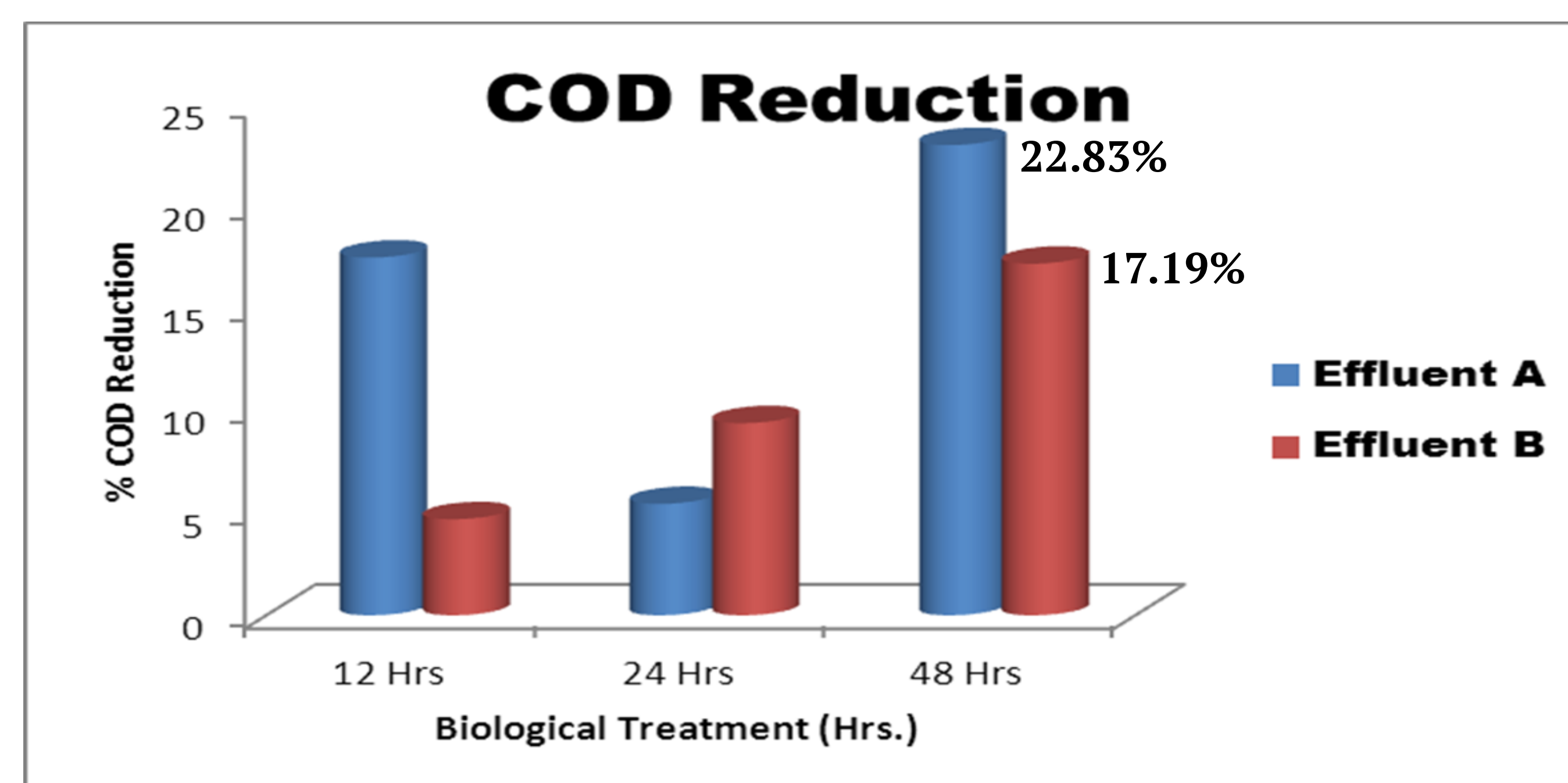
A



B



Results



Conclusions

There is an increasing awareness of environmental concerns in industrial processes, and the development of innovative and indigenous technologies is a necessary step to counter the risk of environmental degradation at a local and global level. This study has demonstrated the efficacy of a novel bacterial isolate in reducing COD value of runoff samples from the viscose fibre industry, which may serve as a tool to enable safe disposal of morpholines, especially NMMO. Looking to the future, research and development of further such techniques in other sectors must be prioritized, so as to create a cleaner, greener, and safer industry footprint on the environment.

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References

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