European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 07, Issue 07, 2020

Analysis Of Nylon 6 As Microplastic In Harike Wetland By Comparing Its IR Spectra With Virgin Nylon 6 And 6.6

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ABSTRACT

This study is based on different IR spectra of nylon 6 and nylon 6.6 who are most common plastic in environment comes from domestic and industrial waste. Study is focused on amid II band (C=O stretch) Amid I band (NH bending) NH stretch. Water filter for sampling and collection of debris from Harike wetland was done with help of plankton net in winter season. By using standard digestion and density separation methods suspected miscroplastic collected and analyzed by FTIR. IR spectra of both virgin and sample were matched and found that nylon 6 is present in Harike wetland. The source of Nylon may be lateral invasion or from different water bodies who are integral part of Harike wetland.

Keywords:Polymer,Harikewetland,FTIR,Nylon

1. INTRODUCTION

Plastic (Polymer) pollution is showing its presence in both water and land [1]. The effect of their toxicity has been well documented in various reports [2,3]. But there is concern regarding differentiating type of polymer in plastic. Polymers having the property of being durable gives them potential to last long in environment [4]. The Polymer is usually defined by the chemical composition along with its subunits arrangement which further explains its physical strength. There are several types of spectroscopical techniques available, FTIR is one of them which is mostly used as it helps to study the composition of the various types of polymers [5]. Spectroscopic analysis gives the basic information regarding the type of constituent which can be further validated by the other analytical techniques.

Harike wetland is one of the most important northern wetlands of India. I t holds importance for being rich in diversity for both flora and fauna. It occupies an area of 285.1sqkm contributing towards ecological enrichment [6].

In this work, a brief approach for exploring the high resolution Schimadzu equipment, including the sample analysis in vaccum, that helps decreasing interference and noise thereby improving spectral quality is given. Virgin samples of Polyamide (Nylon 6 and Nylon 66) were analyzed and it was shown that this being an easy and simple step towards primary differentiation of nylon 6 from rest of the types of nylons. In addition to this, the recovery of Nylon 6 from water samples of Harike wetland was estimated by evaluating the absorption bands of sample in comparison to virgin Nylon 6 and Nylon 66

2. Methodology

FTIR Analysis

The equipment used was a Schimadzu Spectrometer (8400S) mostly used for research. The bands chosen for Nylon 6 and Nylon 6.6 analysis were in the regions 3000-2800cm^{-1}, 1700-500cm^{-1}.The spectral resolution was 4cm^{-1} along with eight scans. To avoid interference due to moisture, sample was dried in oven at a temperature of 78 degree Celsius till use before and after mixing KBr. (Which was also oven dried at same temperature as that of sample).

Sampling of Microplastic:

Surface sampling in the month of Dec 2018 (using plankton Net with mesh size 50µm to an area 600m with deoth 15cm)

Net washed with distilled water

↓

Organic macro content separated

↓

Remaining washoff treated with hydrogen peroxide (30%) for organic digestion [7]

↓

Sodium Iodide treatment for density based separation[8]

↓

Samples centrifuged at 3500rpm for 15 min followed by collection of supernatant and drying in iven at 55 ºC for 20 min. [8]

Sample Preparation:

Nylon 6 and Nylon 6.6 were received as commercial samples in the form of pellets. The pellets were further converted into films prior to mixing with KBr. The film was measured with respect to its length and breadth prior its analysis through FTIR. The film of sample (both pure polymers and microplastic samples) plus KBr was prepared using a device which is specially used to form film samples for analysis. The film was subjected to a load pressure of 2-3 Kg for 10 min at room temperature resulting in films with diameter 2.6 cm.

3. RESULT AND DISCUSSION

The analysis performed in the atmospheric conditions leads to high interference in spectra in the form of noise. This can be substituted by acquisition of sample under vaccum (Gulmine 2002). The spectra for both Nylon 6 and Nylon 66 showed various bands each corresponding to a particular group characterized by a particular distance in cm^{-1} between two bands[9]..

The spectra of two Nylon types , Nylon 6 and Nylon 66 are shown in Fig 1 and Fig 2 respectively. The results showed that both had different absorption bands including some common bands which were around 3400cm^{-1}, 1500cm^{-1} and 1600cm^{-1}. The common bands correspond to C=O bond (stretch) around 1600cm^{-1} (Amide I band), NH bending around 1500cm^{-1} (Amide II band) along with band around 3400cm^{-1} for NH stretch. The discussed bands are characteristic of Nylon 6 which differentiate it from Nylon 66 having bands as given in Table 1 [10, 11]. FTIR spectra of water samples from harike wetland showed characteristic peaks of Nylon 6 as found for the pure Nylon 6 polymer (Fig 3).

The major difference between the IR spectrum of Nylon types can be attributed to the degree of branching along with the presence of different groups.

Therefore in this work demonstration is given to distinguish Nylon 6 and Nylon 66 by FTIR along with qualitative recovery of Nylon 6 from Harike wetland.

Various studies have been performed using FTIR to study plastic properties and waste water has been recycled to use the water in various fields.

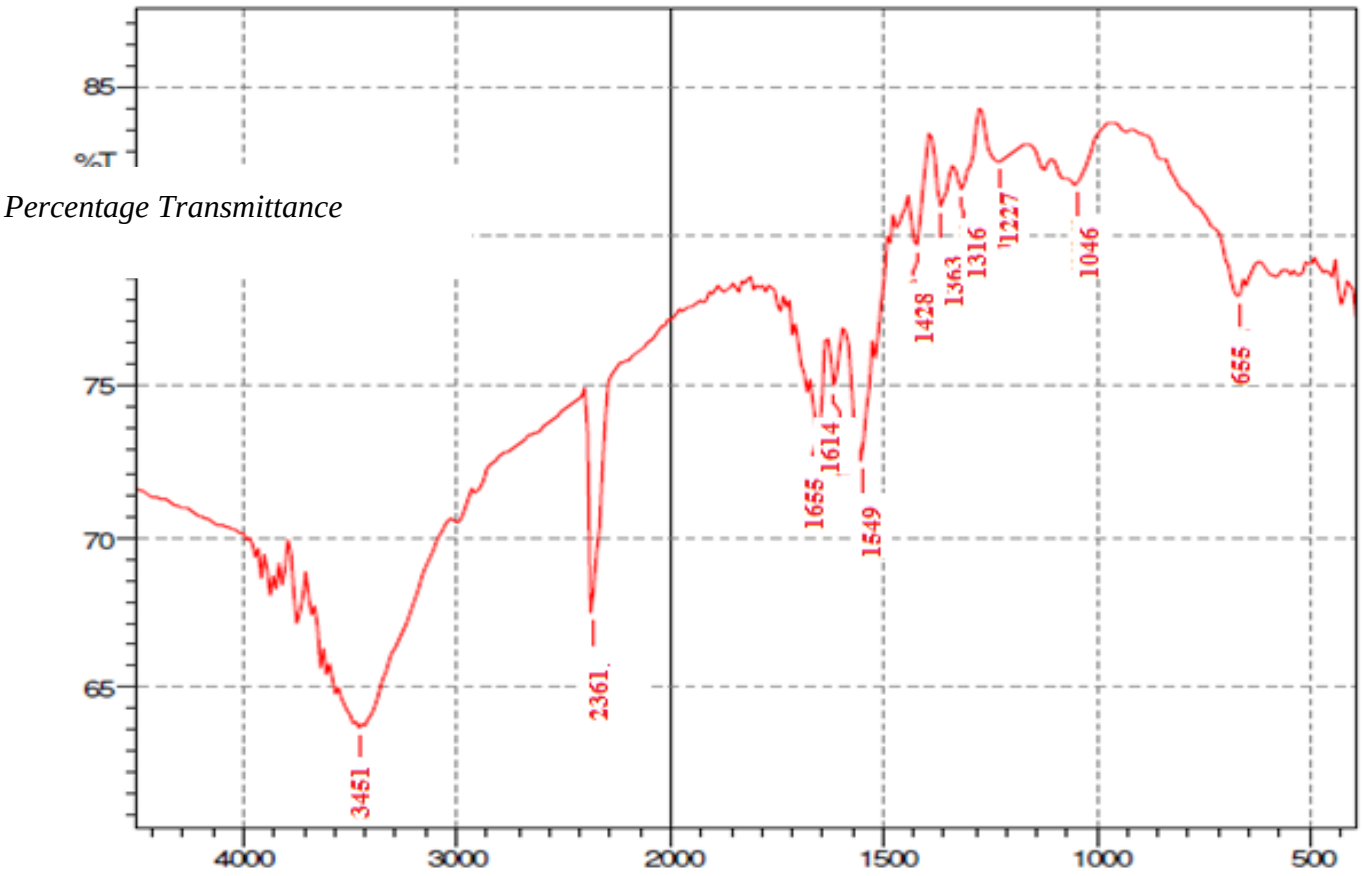

Fig 1: FTIR Spectra of Nylon 6

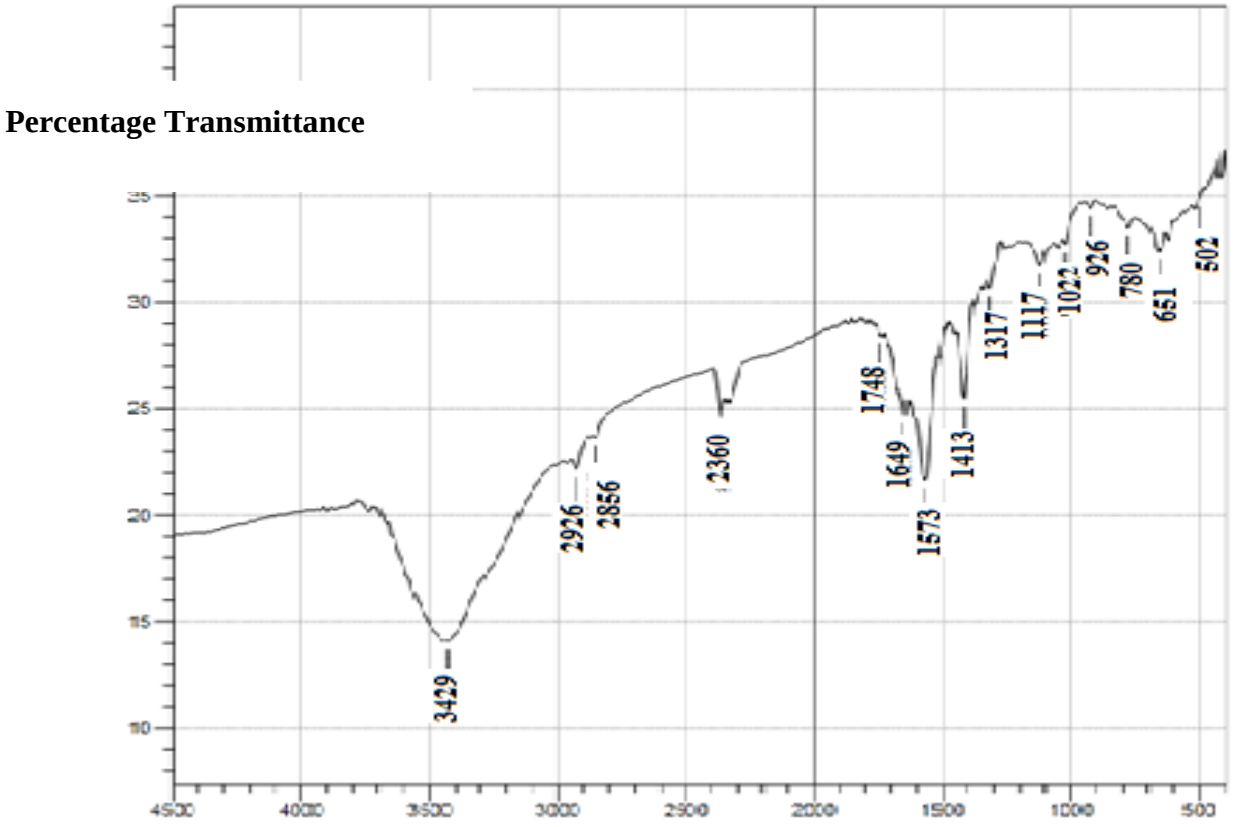

Fig 2: FTIR Spectra of Nylon 66

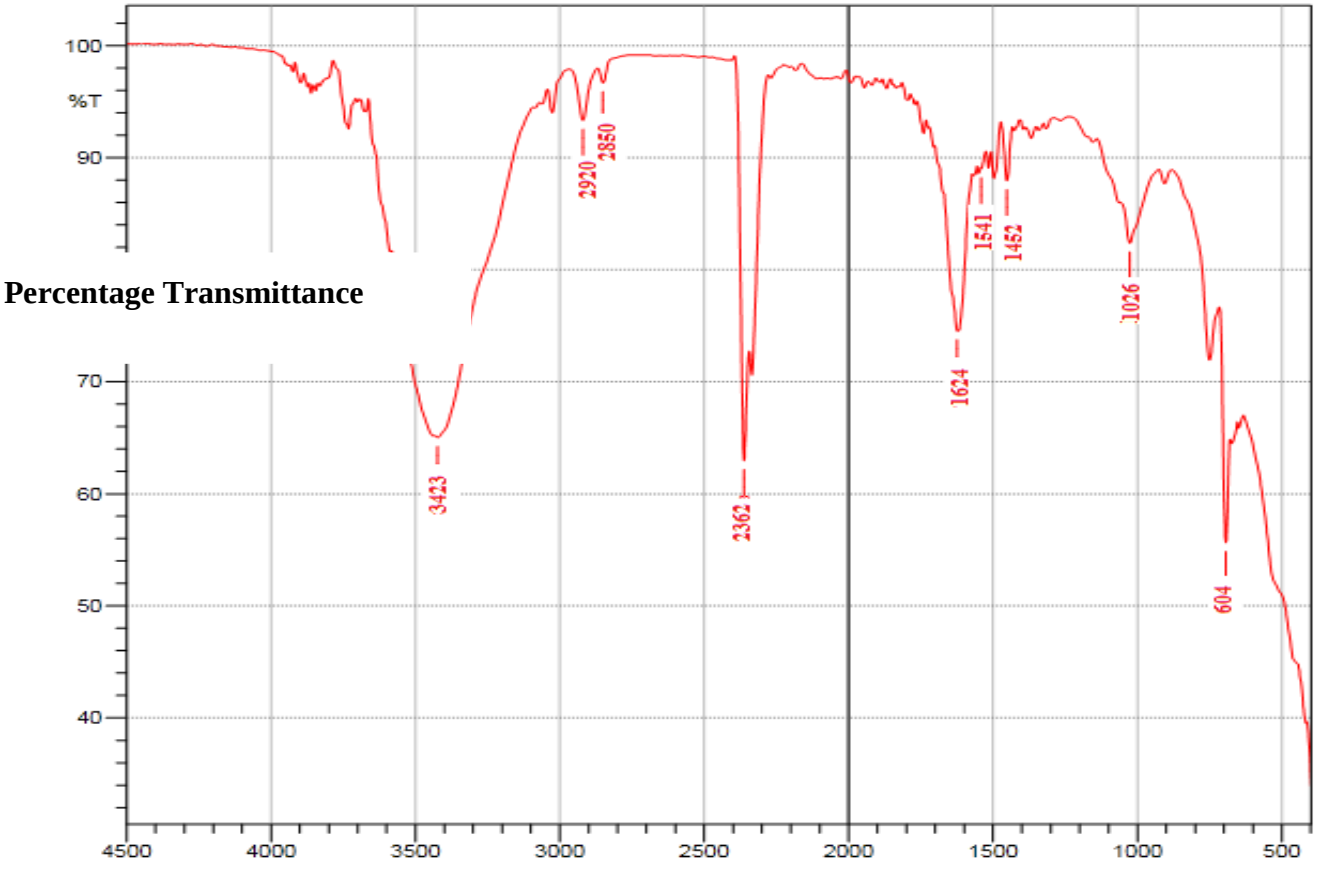

Fig 3: FTIR Spectra of water sample (Marine wetland)

Table 1:

Showing the different absorption bands of Nylon 6 and 66 corresponding to different groups [10, 11]

	Absorption Band (cm^{-1})	**Group Assignment**
Nylon 66	3429	NH stretch
	2926	CH_2 asymmetric stretch
	2856	CH_2 symmetric stretch
	1748	C=0 stretch
	1649	Amide I band
	1573	Amide II band
	1413	NH deformation/ CH_2 scissoring
	1317	Amide III/ CH_2 wagging
	1117	CCH symmetric bending/ CH_2 twisting
	1022	CCH symmetric bending
	926	C-C stretching
	780	NH wagging/CH_2 rocking
	651	C-C Bending
	502	O=C-N Bending

Nylon 6	1549	Amide II band
	1614	Amide I band
	3451	NH stretch

4. CONCLUSION

The contribution of using FTIR analysis was explained taking into account the differences between Nylon 6 and Nylon 66. It was concluded that under proper optimized conditions it was possible to differentiate Nylon 6 and Nylon 66 using FTIR. Also the presence of microplastic in Harike wetland was indicated with type Nylon 6 which can be further analyzed in terms of quantity.

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