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Research Article

Chemical and Physical Assessment of Solid Waste to Synthesize Low Cost Chemicals for Advancing the Solid Waste Recycling

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Abstract— Experimental exposure to the Solid waste's chemical and physical characteristics is essential to implement waste recycling to synthesize low-cost chemicals that can be used for educational laboratory practices. Solid waste collected from various resources contains the raw form of mixed chemicals e.g. chlorides, sulfates, sulfides, nitrates, phosphates, metals non-metals, metalloids, or basic constitutional units of hydrocarbons and their different derivative forms like to create a wide variety of compounds, using carbon (and hydrogen), such as urea or alcohols (like methanol or ethanol) from methane. The most variable routine material in the municipal solid waste stream is food waste. The present research work is to find out the chemical composition of municipal solid kitchen waste by the qualitative study based on chemical and physical assessment and Infrared spectroscopy is a type of spectrum study that uses Fourier transforms (FTIR). An infrared spectrum of a solid, liquid, or gas's emission, absorption, and photoconductivity can be obtained with the use of FTIR, a valuable instrument. In essence, by subjecting material samples to infrared light (IR). The molecular comprise and structure of a substance are ascertained by FTIR analysis, which analyses the absorbance of infrared light at different wavelengths. Solid domestic waste samples are collected from the trenching ground of the municipality, hence the conversion in the production of greener chemicals or low-cost chemicals for advancing solid waste recycling that can be used for educational laboratory practices or as precursor for the preparation of other chemicals.

Keywords—advancing the solid waste recycling, low cost chemicals, municipal solid, chemical characteristics, chemical composition, greener chemicals, waste to chemicals.

1. Introduction

The primary objective of the current research is to investigate the chemical composition of municipal solid kitchen waste through a qualitative study that involves both chemical and physical assessments. The analytical technique employed in this study is Infrared Spectroscopy, specifically utilizing Fourier Transform Infrared (FTIR) spectroscopy.

FTIR spectroscopy is a powerful analytical method that enables the examination of the interaction between matter and infrared light. In this technique, an infrared spectrum is generated, providing information about the emission, absorption, and photoconductivity of a solid, liquid, or gas sample. The Fourier transform aspect of the technique enhances the speed and accuracy of data acquisition.

The process involves exposing material samples, in this case, solid domestic waste from the trenching ground of the municipality, to infrared light. The resulting spectrum allows for the identification and analysis of the molecular composition and structure of the substances present in the waste. By measuring the absorbance of infrared light at different wavelengths, FTIR analysis provides valuable insights into the chemical makeup of the samples.

The significance of this research lies in its potential to contribute to the development of greener or low-cost chemicals through the recycling of solid waste. The data obtained from the FTIR analysis can be utilized to understand the molecular characteristics of the kitchen waste, paving the way for the production of environmentally friendly chemicals. These chemicals can find applications not only in industrial processes but also in educational laboratory practices. Moreover, the identified components can serve as precursors for the synthesis of other chemicals, further expanding the possibilities for sustainable and resource-efficient practices.

In summary, this research aims to harness the information derived from FTIR spectroscopy to transform municipal solid

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kitchen waste into valuable resources, promoting advancements in solid waste recycling and the development of eco-friendly chemicals for various applications.

Wastes specifically, municipal solid trash is represented by [1,2]. an unused basis of raw chemicals or basic constitutional units of hydrocarbons and their different derivative forms like methane, alcohols (such as methanol or ethanol), and urea are among the many compounds that can be produced from carbon (and hydrogen). This analysis looks at the economics of the waste to chemical process is the aim of present research paper. Solid waste [3] collected from various domestic and industrial sources is really varied. As a result, depending on their sources, they have different physical and chemical properties. When the sample under investigation interacts with the infrared radiation, FTIR measures a sample's absorbance of infrared light at different wavelengths to determine the sample's molecular composition and structure.

2. Materials and Methods

Understanding the chemical characteristics of waste is pivotal for assessing the efficacy of any treatment process aimed at managing and disposing of waste materials. In this context, the research initiative involves the collection of samples during the summer season from the wet section of the trenching ground managed by the Indore Municipal Corporation (IMC) in Indore. These samples, drawn from the municipal trenching ground, are inherently heterogeneous, reflecting the diverse composition of waste materials disposed of in the area.

The initial steps of the study involve testing the solubility of the collected samples in water. This solubility assessment is a fundamental step as it provides insights into the potential for dissolution of various components within the waste. Understanding solubility is crucial for determining the water-soluble fraction of the waste, which can have implications for environmental impact and treatment strategies.

Following the solubility check, the research delves into a more detailed chemical characterization of the waste samples. This involves elemental testing to identify and quantify the presence of specific chemical elements within the waste. Elemental analysis is essential for gaining a comprehensive understanding of the inorganic composition of the waste, allowing researchers to pinpoint the types and amounts of elements present.

Simultaneously, the study explores the organic composition of the waste samples by identifying and characterizing the various functional groups present. This involves assessing the different types of chemical bonds and structures within the organic components of the waste. Techniques such as infrared spectroscopy or other spectroscopic methods may be employed for this purpose. Understanding the organic functional groups is crucial for gauging the potential reactivity and biodegradability of the waste.

As the experiments progress, the observations made during the chemical characterization phase contribute to building a detailed profile of the chemical makeup of the waste samples. This information is invaluable for designing appropriate treatment processes or exploring potential avenues for recycling or reusing specific components of the waste. Moreover, it aids in assessing the environmental impact of the waste and devising strategies for sustainable waste management.

In summary, the research focuses on gathering comprehensive data on the chemical characteristics of waste samples collected from the IMC Indore trenching ground during the summer season. The solubility assessment, elemental testing, and characterization of organic functional groups collectively contribute to a nuanced understanding of the waste's composition, laying the groundwork for informed decision-making regarding waste treatment and management processes.

Information on the chemical characteristics of waste is essential in determining the usefulness of any treatment process. For this purpose, samples were collected in the summer season from the wet section of trenching ground of IMC Indore. Heterogeneous Samples were collected from the municipal trenching ground. After checking its solubility in water and chemical characterization viz, elemental testing and their corresponding organic functional group, the following observations were made, performing experiments with the samples collected so far.

Table- 1: Recycling of waste material containing raw chemical contents to organic chemical synthesis

S.No.	Peak	Intensity	Corr. Int.
1	402.18	27.04	56.86
2	410.86	12.55	17.21
3	432.07	21.17	5.8
4	472.58	26.18	2.55
5	487.05	28.14	2.55
6	503.44	29.27	1.55
7	579.63	33.82	0.68
8	591.21	34.42	1.13
9	626.89	37.92	0.8
10	1529.62	88.07	0.18
11	1632.81	68.22	0.7
12	3047.66	80.31	0.16
13	3064.06	77.39	0.19
14	3080.45	74.56	0.21
15	3094.92	71.76	0.24
16	3173.04	54.84	0.3
17	3186.54	52.55	0.28
18	3192.33	51.65	0.29
19	3201.97	50.20	0.38
20	3208.72	49.5	0.33
21	3222.23	48.26	0.22
22	3234.76	47.32	0.25
23	3261.77	46.73	0.16
24	3272.38	46.66	0.08
25	3290.70	46.50	0.16
26	3296.49	46.45	0.28
27	3510.60	66.91	0.66

The Fourier transform spectrometer converts the raw data from the broad-band light source to obtain the absorbance level at each wavelength. Generally, the quantity of sample

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required for a practical analysis is very small and most analyses can be done relatively quickly with little sample preparation. The x-axis—or horizontal-axis represents the infrared spectrum, which plots the intensity of infrared spectra. The peaks, which are also called absorbance bands, correspond with the various vibrations of the sample's atoms when it's exposed to the infrared region of the electromagnetic spectrum. Fourier Transform Infrared spectroscopy is used to determine the functional group in any given organic sample given dipole moment exists as dipole moments that change as a function of time are capable of absorbing IR.

Table-2 FTIR Spectral data of kitchen waste wet sample (Water soluble)

Physical State & Appearance- Semisolid Color- Greenish black Odor- Irritating & Pungent Solubility- This Physical parameter is helpful in the identification and synthesis of compounds. i) Partially soluble in water. ii) Partially soluble in alcohol.			
Testing of municipal solid waste sample		Experimental exposure	Waste to chemicals (Synthesis)
Nitrogen estimation 1. Organic elemental analysis 2. Kjeldhal flask Experiment	-NO2 group by Mulliken's Test	General organic functional group testing	1) Meta Di Nitro Benzene 2) Nitro Phenol
	Amines - NH2 group by Dye test	General organic functional group testing	1)Aniline 2)Urea
	Acetanilide – NHCOCH3 by Dye test	General organic functional group testing	1)Benzenilide 2)Phenyl Azo Beta Napthol

The results so obtained fulfil our waste-to-chemical approach for the synthesis of new products and give a second chance at life to the carbon and hydrogen they contained and this is the main objective of the present work.

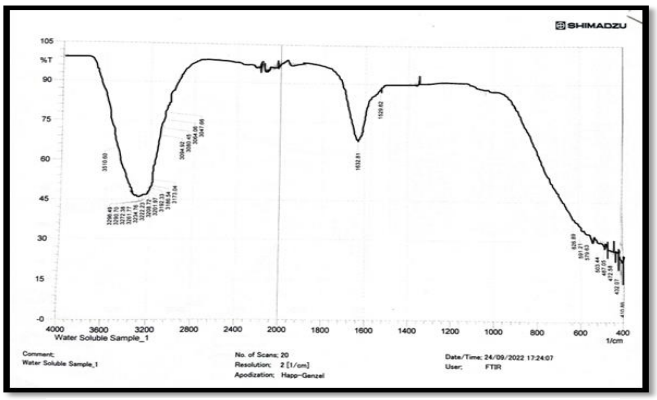

Fig.1 FTIR Spectra of kitchen waste wet sample dissolved in water

3. Results and Discussion

These experiments and results so obtained refer to the conversion of organic waste to generic chemicals viz. Meta Di Nitro Benzene, Nitro Phenol, Aniline, Urea, Benzenilide, Phenyl Azo Beta Naphthol, and many more chemical substances, based on their functional groups. The generic term is based on grading as these synthesized chemicals are not ready to use for research or analytical purpose but after applying some rigid purification methods these chemicals can be used (as pure as special grade chemicals). In this manner, various organic acids, alcohols, Phenols, and corresponding derivatives have been synthesized using a systematic protocol of the preparation methods recommended. Chemical characteristics include pH, Nitrogen, and total Carbon, ratio of Carbon and Nitrogen has been determined using qualitative and quantitative methods. FTIR spectral studies have been made to ensure the functional group of synthesized compounds [4,5]. In Fig, it is clear that FTIR starts at a high frequencyThe three wavenumber ranges that comprise the IR spectrum are the far-IR spectrum (400 cm-1), mid-IR spectrum (400–4000 cm-1), and near-IR spectrum (4000–13000 cm-1). The most commonly used spectrum is the mid-IR spectrum, while far- and near-IR spectrums are also employed to provide details on the materials under test. That interpretation was mostly concerned with FTIR studies in the mid-IR spectrum.

The fingerprint regions are further examined to completely identify the molecule.[6,7]
The fig. indicates the peaks in the range of 400- 680 cm-1(C-X stretch) evidencing the presence of alkyl halides in the sample. Nitro compounds are indicated by the existence of a peak at 1529 cm-1 (the N-O stretch) in the sample. The presence of amides is indicated by the peak at 1632 cm-1 (C=O stretch) in the sample. 1590-1655 cm-1 (N-H stretch). Strong intensity at between 1650 and 1600 cm-1, informing aromatic compounds or double bonds. There were no triple bond regions (2000–2500 cm–1) found, indicating that the material lacked C–C bonds.[8] Aldehyde has not been found to exhibit a distinct peak between 2700 and 2800 cm-1. Absorption bands between 3010-3100 cm-1 (Ar C-H stretch) indicate the presence of aromatic compounds. Absorption bands between 3200-3400 cm-1 (N-H stretch) indicate the presence of amides. A hydrogen bond is seen by a large absorption band in the 3650–3250 cm-1 range. The presence of hydrate (H_2O), hydroxyl (- OH), ammonium, or amino is confirmed by this band. The spectra at frequencies of 1600–1300, 1200–1000, and 800–600 cm-1 reveal the presence of hydroxyl compounds. The absorption band found in the absorption at around 3510 cm-1indicates the presence of an oxygen-related group (phenol or alcohol) in the molecule. [9]

4. Conclusion and Future Scope

Using a qualitative analysis based on chemical and physical evaluation, the results of present study shows the chemical composition of municipal solid kitchen trash with the help of Fourier transforms (FTIR), which is a method of studying spectrums in infrared spectroscopy. An invaluable tool, the Fourier Transform Infrared (FTIR) analyses the emission, absorption, and photoconductivity of a solid, liquid, or gas in the infrared spectrum. Essentially, through the application of infrared light (IR) to material samples.

FTIR analysis examines the absorbance of infrared light at various wavelengths, determines the molecular makeup and

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structure of a substance. Based on the above experiments, the chemical composition of Kitchen wet waste has been studied using qualitative analytical methods which are based on chemical and physical assessment of kitchen wet waste samples, collected from trenching ground,(MNC). These experiments and results so obtained refer to the conversion of organic waste to generic chemicals. After the analysis of functional groups present in the wet sample, preparations of generic chemicals have been done, applying some rigid purification methods these chemicals can be used as pure as special grade chemicals. In this manner, various organic acids or alcohols, phenols, or corresponding derivatives can be synthesized using the systematic protocol of the preparation methods recommended. The presence of functional groups can be determined with the use of FTIR spectra, which start at a high frequency.

To fully identify the molecule, more examination is conducted on the fingerprint regions. Hence that will reduce the time consumption for trending treatment methods and also assist the designers and manufacturers in the production of generic chemicals and alternative and faster methods of garbage disposal.

Conflict of Interest
The writers have indicated that they have no conflicts of interest.

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Authors' Contributions
Author-1performed experiments and researched literature and conceived the study. Author-2 involved in protocol development. Both authors reviewed and edited the manuscript and approved the final version of the manuscript.

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