A

Major Project Report

On

PREPARATION OF MCM-41 AND ITS CHARACTERIZATION

Submitted in partial fulfilment of the requirement for award of the degree of

BACHELOR OF TECHNOLOGY

In

CHEMICAL ENGINEERING

SESSION 2023-24

UNDER THE SUPERVISION OF

SUPERVISOR	CO-SUPERVISOR	SUBMITTED BY
Dr. Anil Kumar Chandrakar	Mr. Vishnu Prasad Yadav	Pappala Vandana
Professor	Assistant Professor	S Rohin
Department of Chemical Engineering	Department of Chemical Engineering	Rakesh Kumar
Guru Ghasidas Vishwavidyalaya (C.G.)	Guru Ghasidas Vishwavidyalaya (C.G)	Daida Rajesh
		Mukesh Kumar

Department of Chemical Engineering

School of Studies of Engineering & Technology

Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)-495009

CERTIFICATE OF APPROVAL

This is to certify that the thesis entitled **"PREPARATION OF MCM-41 AND ITS CHARACTERIZATION"** submitted by **Mr. S Rohin** (Roll no.- 20101050), **Miss. Pappala Vandana** (Roll no.- 20101040), **Mr. Rakesh Kumar** (Roll no.- 20101047), **Mr. Daida Rajesh** (Roll no.- 20101016) **& Mr. Mukesh Kumar** (Roll no- 20101035) in fulfilment of the requirements for the degree of **Bachelor of Technology** in **Department of Chemical Engineering of batch 2020-24**, is a record of bona fide and original research work carried out by them under our guidance and the thesis does not include any work which has previously been submitted for the award of other degree, diploma, associate-ship, fellowship, or other similar title to them. We, further certify that the work reported in this thesis was carriedout independently by the candidates.

Approved by

Dr. Raghwendra Singh Thakur
Head
Department of Chemical Engineering
School of Studies Engineering & Technology
Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.

02/05/24

Signature

विभागाध्यक्ष, रासायनिक अभियांत्रिकी
HoD, Chemical Engineering
प्रौद्योगिकी संस्थान/Institute of Technology
गुरू घासीदास विश्वविद्यालय, बिलासपुर (छ.ग.)
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

Guided by

Dr. Anil Kumar Chandrakar
Professor
Department of Chemical Engineering
School of Studies Engineering & Technology
Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.

02/05/24

Signature

Co-Guided by

Mr. Vishnu Prasad Yadav
Assistant Professor
Department of Chemical Engineering
School of Studies Engineering & Technology
Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.

02/05/24

Signature

ABSTRACT

This report details the synthesis and characterization of Mobil Composition of Matter No. 41 (MCM-41), a mesoporous silica material, using Tetraethyl Orthosilicate (TEOS) as the primary silica source. MCM-41 is known for its regular pore structure and high surface area, which render it an ideal candidate for applications across catalysis, adsorption, and controlled drug delivery systems. The preparation procedure involved the use of TEOS in conjunction with cetyltrimethylammonium bromide (CTAB) as the templating agent, and an aqueous solution of sodium hydroxide (NaOH) to catalyze the hydrolysis and condensation of TEOS.

The synthesis followed a typical sol-gel process where TEOS was hydrolyzed in an alkaline medium to form a silica sol, followed by the addition of CTAB which directed the formation of a highly ordered mesoporous structure upon condensation. The resultant material was subjected to aging and subsequent calcination to remove organic components and ensure the integrity of the silica framework. The report elaborates on the critical synthesis parameters including pH control, aging time, and calcination conditions that influence the structural properties of MCM-41.

Characterization of the synthesized MCM-41 was comprehensively conducted using X-ray Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FTIR), and Scanning Electron Microscopy (SEM). XRD analysis confirmed the hexagonal pore arrangement characteristic of MCM-41, with distinct reflections indicating well-ordered mesoporous architecture. FTIR spectra provided insights into the silica network structure, showing typical bands associated with Si-O-Si stretching vibrations and further confirming the removal of organic templates post-calcination. SEM images illustrated the morphological aspects, depicting uniform mesoporous particles with a highly regular pore structure.

The successful synthesis and detailed characterization of MCM-41 underscore its potential for enhanced performance in targeted applications, leveraging its tunable pore size and surface chemistry. Future work may explore functionalization of the surface to improve interaction with specific molecules or enhance material stability under varied operational conditions.