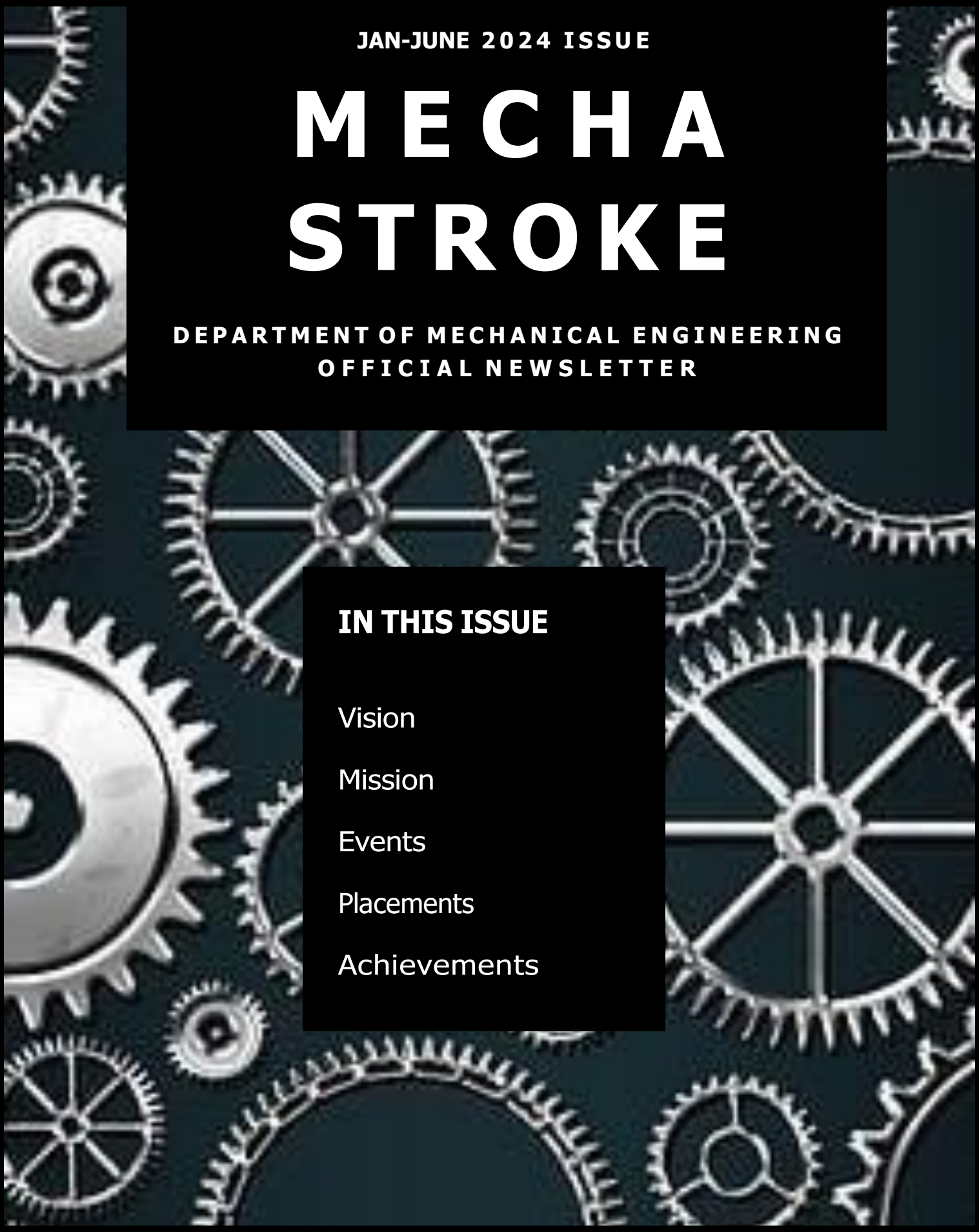
JAN-JUNE 2024 ISSUE

MECHA STROKE

DEPARTMENT OF MECHANICAL ENGINEERING
OFFICIAL NEWSLETTER



IN THIS ISSUE

Dr. Akhilesh Das Gupta Institute of Professional Studies
Shastri park, New Delhi, 110053
Approved by AICTE and Affiliated to GGSIPU

DR. AKHILESH DAS GUPTA INSTITUTE OF PROFESSIONAL STUDIES

VISION

To produce globally competent and socially responsible technocrats and entrepreneurs who can develop innovative solutions to meet the challenges of 21st century.

MISSION

M1. To Provide Value-Based Education through Multi Grade Teaching Methodologies and Modern Education Facilities.

M2. To Sustain an Active Partnership Program with Industry and Other Academic Institutes with an Aim to Promote Knowledge and Resource Sharing.

M3. To Conduct Value-Added Training Programme to Enhance Employability.

M4. To Provide a Conducive Environment for Development of Ethical and Socially Responsible Technocrats, Managers and Entrepreneurs.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To produce competent mechanical engineers having distinct employability skills, involving innovative ideas to fulfill societal needs.

MISSION

M1. To provide resourceful education through training and skill upgradation.

M2. To inspire the young dynamic minds towards innovation and research to meet the societal needs and responsibilities.

M3. To strengthen the industry-academia interface for better employability.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1. Graduates shall excel in their career through participation in multidisciplinary fields.

PEO2. Graduates shall develop cost effective innovative technologies and methodologies to solve engineering problems and contribute to sustainable development.

PEO3. Graduates shall have a successful career in academia, industries or as an entrepreneur to serve societal needs.

INDUSTRIAL VISIT

Title: Visit Ingreee Autoventures
Dated: 07/02//2024
Department: Mechanical Department
Venue: Sector M-10, IMT Manesar, NH-8, Bhangrol, Gurugram
Objective: Improved understanding of students about mechanical engineering and automotive manufacturing processes. Academic enrichment: academic learning by providing real-world context to theoretical concepts.

EVENT- ACREX

Title: ACREX
Dated: 15, 16 ,17 Feb 2024
Department: Mechanical Engineering
Venue: India Expo Center & Mart.
Objectives: Promote innovation and sustainability in HVAC industry through expo.

GUEST LECTURE

Title: BOSCH
Dated: 29 March 2024
Department: Mechanical Engineering
Venue: Seminar Hall Room No. 2310
Objectives: New developments in Automotive technology exhaust gas treatments.

EVENTS- COLLEGE FEST

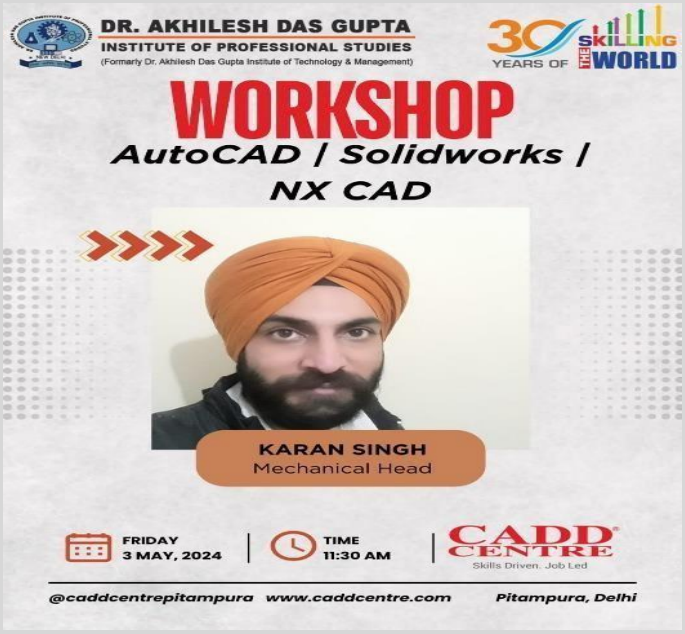
Dated: 13 March 2024
Department: Mechanical Engineering
Venue: Seminar Hall Room No. 2310
Objectives: Foster creativity and presentation skills among college students in tech fest.

Dated: 13 March 2024
Department: Mechanical Engineering
Venue: M.E. Computer lab
Objectives: Foster critical thinking and diplomacy skills through debates on global issues

Dated: 14 March 2024
Department: Mechanical Engineering
Venue: Seminar Hall Room No. 2310
Objectives: The objectives of the presentation on space exploration include educating about space objects, planets, highlighting ongoing missions.

Dated: 14 March 2024
Department: Mechanical Engineering
Venue: Seminar Hall Room No. 2310
Objectives: Enhance knowledge, promote learning, and foster camaraderie among mechanical engineering students through a quiz on technical topics

WORKSHOP



Dated: 03/05/2024
Department: Mechanical Department
Venue: Department of mechanical engineering, Seminar Hall
Objective: The primary objectives of the workshop was to equip participants with fundamental knowledge of AutoCAD/SOLID WORKS/ NX CAD

ACHIEVMENTS

INTELLECTUAL PROPERTY INDIA

ORIGINAL
क्रम सं/ Serial No. : 172104

पेटेंट कार्यालय, भारत सरकार | The Patent Office, Government Of India

डिजाइन के पंजीकरण का प्रमाण पत्र | Certificate of Registration of Design

डिजाइन सं. / Design No. : 385363-001

तारीख / Date : 30/04/2023

पारस्परिकता तारीख / Reciprocity Date* :

देश / Country :

प्रमाणित किया जाता है कि संलग्न प्रति में वर्णित डिजाइन जो *PORTABLE WATER BOTTLE CUM FRUIT CONTAINER* से संबंधित है, का पंजीकरण, श्रेणी 09-01 में 1.Manoj Kumar 2. Neeraj Kumar 3.Awdhesh Kumar Poddar 4.Ravindra Kumar 5.Alka Sharma 6.Dr. Sanjay Mohite 7.Dr. Anil M. Bisen के नाम में उपर्युक्त संख्या और तारीख में कर लिया गया है।

Certified that the design of which a copy is annexed hereto has been registered as of the number and date given above in class 09-01 in respect of the application of such design to *PORTABLE WATER BOTTLE CUM FRUIT CONTAINER* in the name of 1.Manoj Kumar 2. Neeraj Kumar 3.Awdhesh Kumar Poddar 4.Ravindra Kumar 5.Alka Sharma 6.Dr. Sanjay Mohite 7.Dr. Anil M. Bisen.

डिजाइन अधिनियम, 2000 तथा डिजाइन नियम, 2001 के अध्यधीन प्रावधानों के अनुसरण में।
In pursuance of and subject to the provisions of the Designs Act, 2000 and the Designs Rules, 2001.

जारी करने की तिथि :
Date of Issue : 06/09/2024

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ELSEVIER

Recent advances of biogas reforming for hydrogen production: Methods, purification, utility and techno-economics analysis

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ARTICLE INFO

Handling Editor: Ibrahim Dincer

Keywords:
Biogas reforming
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Catalysts
Thermodynamic equilibrium
Economics

ABSTRACT

In recent times, there has been an amplified interest in exploring fresh applications of biogas, attributed to the rising concerns surrounding climate change and an enhanced emphasis on the utilization of renewable energy sources. This manuscript undertakes a comprehensive assessment of recent advancements in the domains of dry, bi-, and tri-reforming. Notably, it emphasizes situations in which the CO_2 present in biogas assumes the role of an oxidant or partial oxidant. A comparative evaluation of various techniques and the exploration of recent catalysts employed in the reforming process and techno-economic biogas conversion applications are also deliberated in this analysis. Biogas conversion exhibits economic feasibility, typically with a payback period ranging from 4 to 6 years. Opting for a higher reaction temperature within the range of 630–900 °C is typically favored as it results in increased CH_4 and CO_2 conversions within the bi-reforming of the biogas process. Similarly, the temperature range is maintained between 750 and 850 °C and 550–1000 °C or above (depending on various factors) for dry reforming and tri reforming respectively. In general, biogas can undergo conversion processes to produce hydrogen, methanol, compressed natural gas, liquid fuel, wax, and form of heat. The inclusive conversion of biogas efficiency ranges from around 35%–80%, depending on the specific type of product being generated.

1. Introduction

The never-ending rise in worldwide energy demand can be attributed to the fact that human activities are driven by energy intensive appliances. Consequently, the per capita energy consumption of a country is widely recognized as a significant indicator of its economic enlargement [1]. In the present era, energy is not solely perceived as a mere factor of production; it is also widely recognized as a strategic resource that serves as a fundamental commodity influencing international relations and exerting a major effect on the global economy and political dynamics [2]. The patterns of global energy and electricity demand are present in conjunction with the corresponding worldwide CO_2 emissions [3,4] as shown in Fig. 1.

The worldwide consumption of fossil fuels experienced a notable increase during the 19th century due to the rapid processes of urbanization and industrialization [5]. It is noteworthy to highlight that conventional based fossil fuels have established themselves as the dominant source of energy, accounting for 81% of global power generation. Specifically, natural gas, coal, and oil contribute 21.6%, 28.1%, and 31.7% respectively [6]. However, the steep increase in fossil fuel prices poses an additional economic burden on countries that rely on oil imports [7]. Due to the surge in fuel prices, the transportation costs of essential goods escalate, resulting in increased inflation rates on a global scale. This has sparked critical debates regarding the management of conventional fuel scarcity. Conversely, in the present context, environmental degradation has emerged as one of the most pressing global challenges for the scientific community operating in affected areas [8]. There is no doubt that modern advanced technology has unequivocally demonstrated its ability to introduce numerous efficient and innovative approaches to address this issue [9]. In conclusion, a substantial number of researchers argue that fostering greater attention to unconventional fuels can serve as a viable resolution to this concern [10]. Therefore, research initiatives have been concentrated on identifying suitable and economically efficient energy resources for the production of renewable fuels in both gaseous and liquid forms [11,12].

The motivation behind examining renewable energies stems from concerns regarding the exhaustion of petroleum-derived resources and global warming. The adoption of sustainable energy options within energy markets is driven by their mitigating environmental pollution, potential for viable energy development, and improving domestic

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ELSEVIER

Full Length Article

Simulation modelling of hydrogen production from steam reforming of methane and biogas

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ARTICLE INFO

Keywords:
Steam reforming
Hydrogen production
Numerical simulation
Biogas

ABSTRACT

The use of fossil fuels in energy systems has environmental consequences, which are driving investigations into H_2 production. While steam methane reforming is the most well-known method for producing H_2, other thermochemical pathways are becoming more prevalent. Steam-reforming of biogas is also a beneficial procedure for producing eco-friendly hydrogen gas and minimizing the burden on fossil fuels. In this study, a simulation modelling of steam methane reforming (SMR) and steam biogas reforming (SBR) are presented. The model reveals the hydrogen production reaction mechanisms and validates its performance through simulation analysis using COMSOL Multiphysics 5.6 software (finite element analysis). The developed model has been validated by available previous experiments and simulation work for biogas reforming with various compositions as well as the methane reforming process. The core aim of this study is to estimate the yield of H_2 for SMR, and H_2 and CO for SBR at steam carbon ratio (S/C) from 1 to 3 with various temperatures, and find the optimum temperature for the reforming process. The yields of hydrogen (mol/mol-CH_4) are achieved higher from SMR as 12% and 22 % for comparison with the experiment and previous simulation study at S/C = 2, at a temperature of 700 °C. The H_2 yields (mol/mol-CH_4) are achieved higher as 30% at 800 °C, 21% at 1000 °C, and 20% at 1200 °C (average percentage of mol for steam carbon ratio from 1 to 3) and compared with previous simulation study at the same operating temperatures, stated by SBR. The findings indicate that the proposed work offers a viable method for utilizing distributed renewable methane resources to fuel cells and generate local electricity.

1. Introduction

Hydrogen is recognized as a highly auspicious energy carrier because its combustion does not generate greenhouse gases or pollutants [1]. However, the majority of hydrogen is currently produced from fossil fuels through the steam reforming of natural gas accounting for nearly half of its overall production [2,3]. As the demand for energy increases, while the fossil fuel reserves continue to diminish, the production of sustainable hydrogen must rely on renewable sources. Biogas is commonly generated through biodegradable substrates made of organic material under anaerobic conditions which provides an attractive renewable alternative for replacing or supplementing fossil fuels in hydrogen production. The composition of biogas primarily depends on the specific substrate utilized in the biogas digester, which may include agro-industrial waste, animal farm manure, sewage sludge, municipal solid waste, energy crops, and other organic waste materials [4,5].

The two main constituents of biogas are CH_4 (40–80%) and CO_2 (20–60%), it also presents small amounts of H_2S, N_2, H_2O, O_2, and siloxanes [6–10]. It has been reported that the presence of H_2S and siloxanes can significantly decrease the catalyst (Ni-based) activity during the reforming of the biogas process. Therefore, it is necessary to eliminate these components before conducting the biogas reforming operation [6–10]. The process of steam reforming of biogas (SRB) incorporates the group of dual reforming reactions, namely the dry reforming of methane (DRM) and the steam reforming of methane (SRM), both of which exhibit significant endothermic characteristics. Table 1 presents a compilation of chemical reactions that typically take place during the steam reforming process of biogas or methane. The primary outcomes of significance in the reforming of biogas are hydrogen and syngas.

To achieve a significant conversion of methane, it is obligatory to operate the steam reformer at high temperatures between 973 and 1273 K. Considering the endothermic nature of the process, it is crucial to have an efficient heat source to provide the necessary energy to drive the reactions [16]. Due to the presence of CH_4 and CO_2 as the primary

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"Innovation is moving at a scarily fast pace
and
mechanical engineering is at the heart of solving real-world challenges."

Bill Gates

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Mr. NAMAN KR. BAJPAI (A.P)

HEAD OF DEPARTMENT
Mr. NEERAJ KUMAR