

EXECUTIVE SUMMERY

Motor gasoline, which is used in Spark ignition engine, is a multicomponent mixture of various hydrocarbons. These hydrocarbons have different combustion characteristics. To produce a high quality gasoline molecular management is the present day concept of the refining industry. Fuel specifications for gasoline are becoming very stringent over the years. To meet these specifications new processes are emerging at the refinery horizon. In this context Bharat Stage-V gasoline, which would be required in Indian market in near future has to meet tight specifications in terms of Sulphur, octane number and olefin contents. The final gasoline which is produce in refineries is a blending component coming from various processes namely hydrocracking, thermal cracking, FCC, reforming, alkylation and isomerization. Out of these processes, isomerization of light naphtha into high-octane naphtha is a great relevance.

Thus, isomerization of n-alkane into high-octane number di- branched alkanes is an important challenge for petroleum refining industries. Thermodynamically lower temperature is favored for the isomerization of light alkanes into di-branched isomers. The conventional commercial catalyst namely chlorinated Pt/Al₂O₃ works at low temperature but it is easily poisoned and not ecofriendly. In addition, of Pt/Al₂O₃ many isomerization catalysts such as Pt/zeolite Pt/sulphated zirconia and others have been developed and used in recent past. But these catalyst have certain drawbacks like resistance to water, and Sulphur in feed, and they are non-regenerable, secondely these catalyst worked at high temperature resulting low isomerate yield.

Thus, the development of isomerization catalyst to replace the conventional catalyst is an area of research worth exploring and occupied mind of researcher world over.

The present work is an effort to developed HPA based sulphated zirconia catalyst effectively promoting firstly hydrogenation /dehydrogenation function and protonic acid function. Thus, heteropoly acids supported on oxidic material was chosen as an appropriate material for the isomerization reaction. Oxidic support could provide the dehydrogenation activity and heteropoly acid could support protonation activity.

Heteropoly acid behaves as a bi-functional catalyst and involves in dehydrogenation and isomerization step at the same time. The metal present in the HPA can exist in variable valences, there by supporting dehydrogenation of alkane while it is reduced to lower oxidation state. At the same time, owing to its super acidic nature and the presence of Bronsted acidity, it easily provides proton to form the carbocation, which can be easily isomerized to form more stable carbocation and reacts with a second molecule of alkane to form branched alkane. Keeping all this in view, catalyst was developed by impregnating tungstophosphoric acids (TPA) as active ingredient over sulphated zirconia as high surface area support. Four different synthesis routes viz: hydrothermal synthesis, microwave synthesis, precipitation method and sol-gel method were used for preparation of the catalyst. Catalyst has been characterized by various state of art equipment, viz. BET surface area, pore volume, pore size distribution, X ray analysis, scanning electron microscopy (SEM), Fourier transform infrared (FTIR), Temperature program desorption (TPD), Temperature program reduction (TPR) and Thermogravimetric analysis (TGA) have been used for the characterization of the catalysts.

The sample was crystalline in nature and the total acidity was to be near 0.1 mmol/g. With the impregnation of TPA, surface area and pore volume decreased (80-240m²/g, and 0.06-0.4cm³/g, respectively); while total acidity increased (0.3-0.7mmol/g).

The isomerization activity of the catalysts was evaluated using n-hexane as model hydrocarbon in the fixed bed micro reactor. The pretreatment of the catalyst was done with hydrogen (200 ml/min for 5hr at 250°C) and the reaction was carried out at 150-225°C; weight hourly space velocity (WHSV) maintained at 1-1.5/hr., time on stream was 2hr and the product was collected after every 30 min. Isomerized product was evaluated by gas chromatography. The conversion was found 1-69%. The higher concentration of TPA gave high conversion yield. The catalyst was found to be promising for the targeted reaction, however further research could make the results and catalyst applicable at industrial level also.

The laboratory used fixed bed micro reactor, which was in house design close to ASTM specifications.