CHAPTER I
INTRODUCTION

Petrochemical industry is one of the biggest industries having a continuous growth for the last few decades. Products from petrochemical industry are essentially a part and parcel of human life today ranging from pharmaceuticals, detergents and adhesives to engineering polymers which is a significant portion of today's construction industry.

Further, petrochemical industry mainly depends on eight key raw materials, which are methane, ethylene, propylene, butenes, benzene, toluene, ethyl benzene and xylenes. The latter four together is known as BTEX in the industry and are in the group of aromatic hydrocarbons. A significant portion of raw materials for petrochemical industry is in the BTEX group. In the history, in 1950's, the main source of aromatics was from coal by means of coal coking process and later it was switched to petroleum with the development of process technologies such as catalytic reforming technology which is the best available technologies even today.

Unfortunately, the petroleum as an origin for aromatics seems to have an uncertainty within next few decades with quick depletion of available reserves due to excessive use as an energy source. In the recent history, petroleum consumption for energy needs has been drastically increased with the increased consumption by newly emerging economies countries as China and India. These countries are now closer in consumption figures with United States, Japan and EU who are the biggest consumers in the world. The present forecast of petroleum reserves and demand according to BP statistical review of world energy issued in June 2009 shows that reserves will be end within four decades. Hence, evaluating options for future origins of aromatics as feedstock for petrochemical industry is a vital foresight today to fulfill the creating vacuum of supply in the world.

Fortunately, natural gas will last for more years according to available reserves and demand forecasts and it will be a next available option for aromatics production after petroleum. As natural gas also a non-renewable resource, the ultimate origin for aromatics could be biomass as what is happening in fuel sector today due to several reasons. The technologies to produce aromatics from natural gas

and biomass are under developed and extensive development of technology in the area is needed.

Moreover, conversion of biomass to aromatics is highly challenging task and several studies have already been conducted in one pathway, which can be used for aromatics production. The reaction, which involved the biomass conversion mainly, takes place through synthesis gas, which is also known as syngas, a mixture of carbon monoxide (CO) and hydrogen (H_2). Fischer-Tropsch (FT) synthesis invented in 1920's is a commercially available process that converts syngas to paraffinic hydrocarbons. Presently, the origin of syngas for FT synthesis is natural gas in the world due to its low cost and availability. Possible ways of producing aromatics from syngas today are production of aromatics through the methanol route by combination of metal oxide catalysts and aluminosilicates (Chang., *et al* 1979) or convert it to hydrocarbons by FT synthesis and aromatization by means of catalytic reforming technology. The possibility of developing a catalyst to direct conversion of syngas to aromatic hydrocarbons has been studied for last few decades but technology is not commercially available. The selectivity enhancements of FT products with hybrid catalysts with of Fe, Co or Ru as FT catalysts and acidic zeolite alone or with metal promotions as aromatization catalysts has been widely studied. In addition, in the history, different interest groups have studied several options on converting the syngas to aromatics rich products using variations in catalysts, catalyst support functionality and different process variables.

Finally, similar to the previous works, the purpose of this work is also to analyze combination effect of some proven catalysts for conversion of syngas to aromatics in a single reactor. Fe-based FT catalysts for syngas hydrogenation to hydrocarbon production are proven. In addition, Pt supported on KL zeolite and ZSM5 are proven for aromatization of paraffinic hydrocarbons. In this work, the combination effects of Fe-based FT catalysts together with Pt supported on KL zeolite and ZSM5 acidic zeolite will be studied.

Moreover, the effects of metals, which show FT activity, such as Ru, Co and Fe and Ni, which is well-known for hydrogenation activity, impregnated on HZSM5 zeolite will be also studied.