

# Selective Hydroconversion of Diesel Boiling Range Heavy-Aromatics for Xylene-rich BTX Production

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Increasing global environmental concerns limit the use of heavy aromatic products in fuel pools. Hence, there has been a strong demand for upgrading heavy aromatics of diesel boiling range into high value products [1-2]. The  $C_{10}^+$  heavy aromatics from *p*-xylene plants is a representative by-products containing alkyl benzenes, naphtho-benzenes, and polycyclic aromatics such as naphthalene, alkyl-naphthalenes, methyl-biphenyl, and dimethyl-biphenyl etc.

We postulated a two-step catalytic process to convert aromatic-rich by-products into high-value BTX [3]. To achieve high per-pass yield of BTX from aromatic-rich fractions, it is important to convert the 2- and 3-ring aromatics into 1-ring products in high selectivity in the pretreatment reaction followed by selective hydrocracking (HYC) of 1-ring aromatics into BTX. In our previous study, we showed that naphthalene can be converted to tetralin by selective hydrogenation over the  $Mo_2C/\gamma-Al_2O_3$  catalysts [3] and high yield of BTX can be achieved from selective hydrocracking of tetralin over metal-supported zeolites [4].

In this study, the catalytic hydroconversion of  $C_{10}^+$  aromatics from a *p*-xylene plant was studied in a fixed bed down-flow micro-reactor system operated under the total pressure of 40-50 MPa at 375-450 °C.

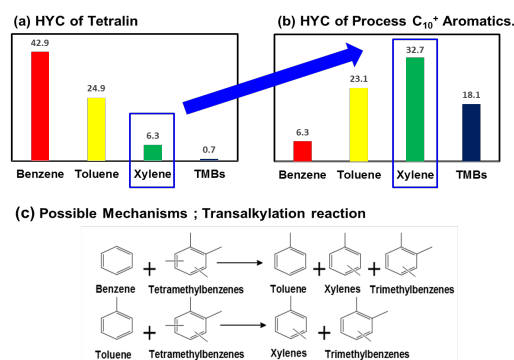
The results of hydrocracking of  $C_{10}^+$  aromatics obtained from 1-step (direct hydrocracking) and 2-step hydroconversion at 425 °C are compared in **Table 1**. Both catalytic processes showed very high level of conversion. Direct hydrocracking resulted in the production of a large amount of  $C_{11}^+$  aromatics as well as alkylbenzenes as a side-products compared with the results from a two-step catalytic process. The final BTX

yield from the two-step catalytic process was much higher than that from the direct hydrocracking due to the better control of exothermic heat and chemical equilibrium involved in the hydroconversion process. Unlike the results from model hydrocracking study with tetralin, xylene content was the highest among BTX and large amount of trimethylbenzenes were co-produced. These results could be due to the transalkylation between benzene or toluene and tetramethylbenzenes present in the feed of  $C_{10}^+$  aromatics (**Figure 1**).

In overall, the  $C_{10}^+$  heavy aromatics from *p*-xylene plants can be selectively converted to xylene-rich BTX. The  $C_{10}^+$  heavy aromatics can also be used as a co-feed of other heavy aromatics (such as LCO and PFO) for the purpose of boosting xylene yield via transalkylation.

**Table 1.** Comparison of results from 1-step and 2-step hydroconversion of  $C_{10}^+$  aromatics.

	Conv.(%)		Liq. Product distribution, wt%							
	Naph. Conv.	M-Naph. Conv.	Nonaros.	Benzene	Toluene	Xylene	TMBs	Alkyl benzenes	$C_{11}^+$ Aros.	Others
1-step	91.1	75.5	4.4	7.2	18.5	18.4	10.9	13.6	18.4	8.7
			BTX Yield			38.3	BTX + TMBs Yield			
2-step	99.1	94.2	7.9	6.3	23.1	32.7	18.1	6.6	3.9	1.4
			BTX Yield			46.1	BTX + TMBs Yield			



**Figure 1.** Comparison of BTX distribution obtained from the hydrocracking of (a) tetralin and (b) process  $C_{10}^+$  aromatics, and (c) proposed transalkylation reactions leading to high yield of xylenes.

## REFERENCES

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