S–MTX Process for Alkylation of Toluene with Methanol to Produce Xylene

Introduction

The S–MTX process is a new process to produce xylenes from toluene, which utilizes methanol as the alkylation feedstock. Methylation of toluene with methanol derived from non–petroleum carbon resources, such as coal and natural gas, is a great potential process for converting the excess toluene into value–added xylenes.

Process Description

After mixing with medium–pressure steam, the toluene and methanol feedstock react in the multi–stage fixed bed reactor.

The products flow into the oil–water separator after heat recovery. The water phase stream is treated in the sewage water stripper to meet the waste water standards before discharging.The oil stream is further separated in the distillation system. The light ends are separated in the stripper and sent to fuel gas network. Toluene and benzene separated from the toluene column overhead are sent back to the reactor. The stream from the toluene column bottom is the product of S–MTX process, which comprises xylenes, ethylbenzene, and C9+ aromatics. The flow diagram for the S–MTX process unit is shown in Fig 1.

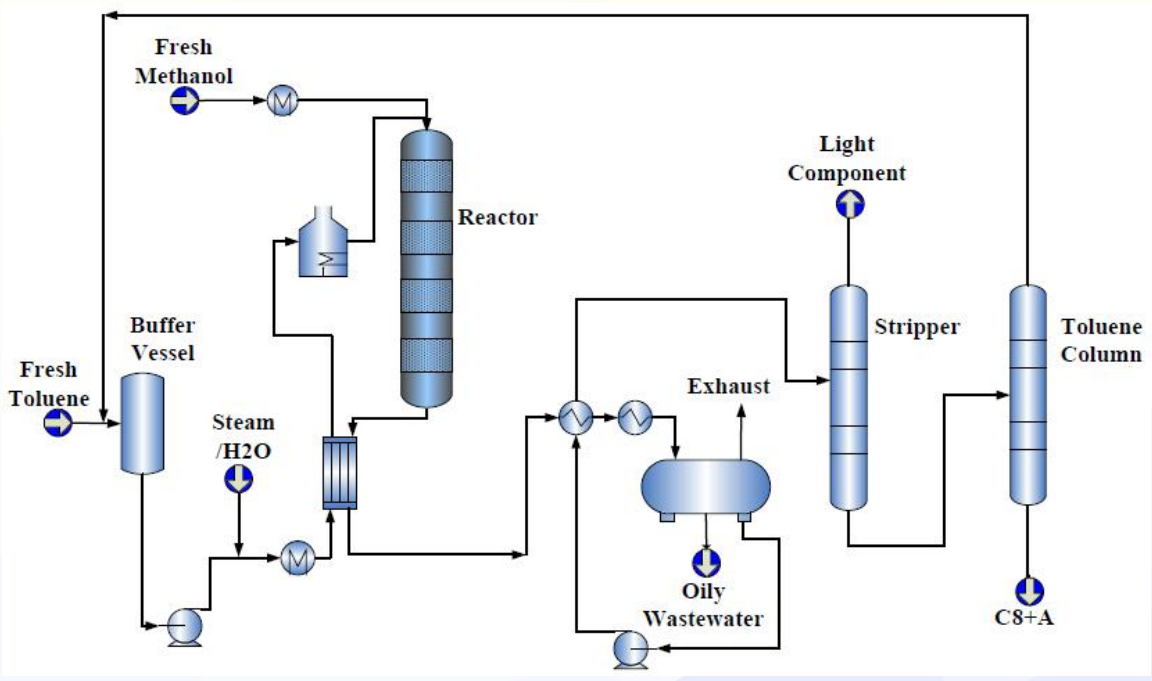

Fig 1. The flow diagram for the S-MTX process

The main process parameters of S–MTX are shown in Table 1.

Table 1. Main process parameters of S–MTX

Reaction temperature,℃	350–450
Inlet pressure, MPa(G)	0.6
WHSV of Toluene, h^{-1}	2–5
Toluene/Methanol, mol/mol	1–4
Water/Methanol, mol/mol	1–4

Features of Technology

- The MTX–1000 catalyst is used for S–MTX technology, which has several advantages including high space velocity, good stability, high methyl utilization, and extremely low ethylbenzene content in the products. Toluene conversion rate is more than 30 wt% and xylene selectivity is above 80 wt%.
- Both methanol and toluene are used as the feedstock to produce high quality xylenes.
- Multi–stage fixed bed reactor and inter–stage quench gas distributor are utilized.
- Thermal integration technology is applied to improve energy efficiency.
- Recovery of oil and methanol in the wastewater can reduce feedstock consumption. The treatment of discharged wastewater is designed according to the quality requirement of process water.
- The consumption of toluene is lower than 0.85 t/t C_8^+A, and the consumption of methanol is lower than 0.45 t/ t C_8^+A.

Catalyst

- The physical properties of MTX–1000 catalyst are shown in Table 2.

Table 2. The physical properties of MTX–1000 catalyst

Catalyst	MTX–1000
Components	Zeolite and alumina
Pellet appearance	white cylinder
Size, mm	Φ1.6–1.8 × 3–10
Bulk density, g/ml	0.67 ± 0.05
Crush strength, N	≥70
Powder ratio, wt%	≤1

- The performance of S–MTX process is shown in Table 3.

Table 3. The performance of S–MTX process

Item	Index
Conversion of Toluene, wt%	≥30
Selectivity of C_8A, wt%	≥80
Conversion of Methanol, wt%	≥99
Regeneration period, month	≥3
Service life, month	≥24

Commercial Application

In December 2012, S–MTX Technology has been first commercialized in the S–MTX demonstration unit with capacity of 200,000 tons/year in SINOPEC Yangzi Petrochemical Company. The produced xylenes and C_9^+ aromatics meet the quality requirements of the downstream units in aromatics complex. In the performance test of the MTX–1000 catalyst, conversion of toluene reached 30 wt%, conversion of methanol was close to 100%, and selectivity of C_8A was more than 80 wt%.