Value Chain Map

Benzene Chart

VCM solutions

Benzene

Heavy Naphtha — Catalytic Reforming
Pyrolysis Gasoline — Treating and Extraction
Toluene — Disproportionation/ Selective TDP; Trans Alkylation; Hydrodealkylation (HAD)
Coke — Separation
PXE Co-prod

Hydrogenation → Cyclohexane

Oxidation → Caprolactone; Cyclohexanol; Cyclohexanone

Cyclohexanol — Oxidation → Adipic Acid → Hydrogenation → 1,6-hexanediol; Adipates; Glycol Adipate; Hexamethylenediamine → AH salt → Nylon 6,6; Co-Polymer Polyamide 6/6,6; Nylon 6

Cyclohexanone — Condensation (Hydroxylamine) → Cyclohexanone Oxime — Beckmann Rearrangement → Caprolactam → Nylon 6; Caprolactam — Sulfonation → Sulfanilic Acid → Phenyl Sulfamic Acid

Nitration (Nitric Acid) → Nitrobenzene

Hydrogenation → Aniline → Follow Aniline Value Chain

Nitrobenzene — Electrolytic Reduction → 4-Aminophenol

Nitration → 1,3-Dinitrobenzene — Reduction → 3-Nitroaniline; Hydrogenation (Hydrogen Sulfide) → m-Phenylenediamine

Pentachloronitrobenzene

Chlorination → 3-Chloronitrobenzene — Reduction → 3-Chloroaniline — Sandmeyer Reaction → 1,3-Dichlorobenzene

Sulfonation → 3-Nitrobenzene Sulfonic Acid — Hydrogenation → Metanilic Acid

Chlorosulfonation → 3-Nitrobenzene Sulfonyl Chloride → 3-Aminobenzenesulfonamide

Reduction → Azobenzene — Hydrogenation → Hydrazo Benzene — Rearrangement → Benzidine

Azobenzene — Oxidation → Azoxybenzene

Hydrazo Benzene — Semidine Rearrangement → 4-Aminophenol

Azoxybenzene — Oxidation → Nitrosobenzene

N-Hydroxyaniline (Ammonium Chloride) → Cupferron

Aniline — Hydrogen; Formaldehyde → Methylene Diphenyl Isocyanate (MDI) → Polyurea; Polyurethane

Aniline — Phosgene → 2,5-Dimethoxyaniline; n-Methyl Aniline (NMA); n,n-Dimethyl Aniline (DMA) → 2-Acetylphenothiazine; n-Ethyl Aniline (NEA); n,n-Diethyl Aniline (DEA)

Aniline — Thermal Deamination → Diphenylamine — Arylation → Triphenylamine; Sulfur → Phenothiazine

Phenylhydrazine → Carbazole

Aniline — Ammonia; Hydrogen Peroxide → Hydroquinone — Hydroxylation → Picric Acid — Ammonia → Dunnite — Dehydration → Picramide — Polyamines → Triaminotrinitrobenzene (TATB)

Picramic Acid → Diazodinitrophenol (DDNP)

Picryl Chloride

Aniline — Ammonia; Sodium Cyanide → Acetone Cyanohydrin — Esterification → MMA — Polymerization → PMMA; Hydrolysis → Methacrylic Acid

Aniline — Phenol → Bisphenol A

Acetone → Isophorone → Isophorone Nitrile → Isophorone Diamine → Isophorone Diisocyanate

Acetone — Aldol Condensation → Diacetone Alcohol — Hydrogenation → Methyl Isobutyl Ketone (MIBK); Methyl Isobutyl Carbinol (MIBC)

Diacetone Alcohol — Ammonia → Triacetone Amine-HALS Compounds

Acetone — Hydrogenation → Isopropyl Alcohol — Esterification → Isopropyl Acetate

Cumene — Oxidation → Acetone; Phenol

Acetone — Bisphenol A — Transesterification (Phosgene) → Polycarbonate; Phenoxy Resins; Epoxy Resins (ECH)

Phenol — Phenolic Resins → Phenol Formaldehyde Resins

Hydrogenation → Ketone Alcohol Oil → Cyclohexanone / Cyclohexanol → Caprolactam → Nylon 6; Adipic acid → Nylon 6,6

Halogenation → Chlorophenols

Alkylation → Alkylphenols → Dimethylphenol → Polyphenylene Ether; 2.6-Xylidine

Alkylphenols → Octylphenol (Sulfuric Acid) → Poly Sulfone; Octylphenol Ethoxylates

4,4-Dihydroxy Biphenyl

Ullmann Reaction → Diphenyl Oxide

Kolbe-Schmitt Reaction → Salicylic Acid → Aspirin

Methylation → Cresol — Phenol Condensate

Cresol — Sulfuric Acid → Dihydroxy Diphenylsulfone — Polyether Sulfone

Dihydroxy Diphenylsulfone — Hydrogen Peroxide → Catechol

Styrene — Dehydrogenation → Ethylbenzene — Alkylation (Ethylene)

Ethylbenzene — Dehydrogenation → Styrene — Polymerization → Polystyrene; Acrylonitrile Butadiene Styrene (ABS); Styrene Acrylonitrile (SAN); Styrene Butadiene Rubber (SBR); Unsaturated Polyester Resins (UPR); Styrene Butadiene Latex (SBL); Styrene Butadiene Styrene (SBS)

Polystyrene → Expanded Polystyrene (EPS); General Purpose Polystyrene (GPPS); High Impact Polystyrene (HIPS)

Ethylbenzene — Dehydrogenation → Diethylbenzene (DEB) — Dehydrogenation → Divinylbenzene (DVB) — Polymerization → Copolymers → Ion exchange Resins

Ethylbenzene — Oxidation → Acetophenone — Hydrogenation → 1-Phenylethanol

Ethylbenzene — Phthalic Anhydride → 2-Ethyl Anthraquinone

Chlorobenzenes (Chlorination)

Monochlorobenzene → Nitration → Nitrochlorobenzenes (Sodium) → Nitrophenol; Nitroanisole (Sodium Methoxide)

Nitrochlorobenzenes — Triphenylphosphine (Phosphorus Trichloride)

Monochlorobenzene — Sulfonation → Dichlorodiphenyl Sulfone (Sulfuric Acid) — Polymerization → Polyether Sulfone; Polysulfone; Polyphenyl Sulfone

Dichlorobenzene — Nitration → 1,2-Dichloro-4-Nitrobenzene

Trichlorobenzene

Hexachlorobenzene → Pentachlorobenzenethiol

Other Alkylbenzenes (Alkylation)

Diisopropylbenzenes (DIPB) (Propylene) → Resorcinol; Hydroperoxides; Hydroquinone

Hydroquinone — Amination (Methylamine) → Metol; Oxidation → Benzoquinone; Disodium Diphenolate (4,4'-Difluorobenzophenone) — Polymerization → Polyether Ether Ketone (PEEK)

tert-Butylbenzene (Isobutene)

Linear Alkylbenzene (LAB) — Sulfonation → Linear Alkylbenzene Sulfonates (LABS)

Branched Alkylbenzene (BAB) — Sulfonation → Branched Alkylbenzene Sulfonates (BABS)

Chlorobenzenes — Chlorination → 3,4-Dichloronitrobenzene — Sodium Methoxide → 2,4-Dinitroanisole

Nitration → 2,4-Dinitrochlorobenzene — Hydrolysis (Ammonia) → 2,4-DinitroPhenol; 2,4-Dinitroaniline; Reduction → 2,4-Diaminochlorobenzene

3,3'-Dichlorobenzidine

Sulfonation → 6-Chloro-3-Nitrobenzenesulfonic Acid; 4-Chloro-3-Nitrobenzenesulfonic Acid

4-Nitrodiphenylamine (Aniline) → N-Isopropyl-N'-Phenyl-1,4-Phenylenediamine (IPPD)

Reduction → Chloroaniline — Amination (Ammonia) → Nitroaniline → Benzotriazole

Maleic Anhydride (Oxidation)

Polybutylene Terephthalate (PBT) — Hydrogenation & Hydrolysis → 1,4-Butanediol (BDO)

γ-Butyrolactone (GBL) → 2-Pyrrolidone — Methylamine → n-Methyl 2-Pyrrolidone; n-Vinyl Pyrrolidone — Polymerization → Poly Vinyl Pyrrolidone

Polyester Polyol

Polybutylene Terephthalate (PBT) (DMT/PTA)

Dehydration → Tetrahydrofuran (THF) — Polymerization → Polytetrahydrofuran

Oxidation → Succinic Acid

Unsaturated Polyester Resins (UPR)

Hydrolysis → Maleic Acid — Catalytic Isomerization → Fumaric Acid; Hydrogenation → Succinic Acid

Benzonitrile

Benzenesulfonic Acid (Sulfuric Acid) — Sulfonation → Hydrolysis (Sodium Hydroxide) → Phenol → Follow Phenol Value Chain

Chart Key

- Other Feeds
- Production Process
- Refer to the Mentioned Chart/Value Chain
- With an Operating Production Plant in Iran

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