BUTADIENE EXTRACTION
PROCESS DESCRIPTION

The plant processes the C_4 fraction through an initial extractive distillation using dimethylformamide (DMF), by separating the butylenes and butanes from the butadiene and acetylenics. With a second extractive distillation it separates the vinyl acetylene, and finally, through a rectification process, it separates the methyl acetylene and the heavy hydrocarbons from the 1,3-butadiene (butadiene).

These three main sections are combined with others using vessels to purify the solvent and to additivate the processing of various chemicals from a condensation water circuit, from a tower water circuit and from a flare and draining header.

The produced butadiene has a minimum title of 99.6%. A recovery of 98% in weight is expected in the project conditions compared to the inflowing butadiene with C_4 fraction.

1.1.1 INITIAL EXTRACTIVE DISTILLATION

This section describes the C_4 fraction incoming in:

- Refined 1 (butylene mix)
- Butadiene
- plus acetylenics which continue their path along the plant for a further separation process.

The C_4 fraction is evaporated in the tank D103 through two warm solvent exchangers (E110A/B) and is fed in the extractive distillation column C101A/B,

In the columns C101A/B, the evaporated C_4 fraction meets the cold countercurrent DMF, coming from the tank D501, which favors the separation mentioned above.

The Butylenes steams flow out of the column top, they are condensed in the exchanger E101 and collected in the tank D101, from where they are partly refluxed to the column and partly sent to stock.

To supply the heat required for the separation and for the solvent heating, 4 reboilers are present at the bottom of the C101A/B: the E102A and B operate through warm process solvent, and the E103/S are steam-operated.

The solvent, rich in Butadiene and acetylenics, flows out of the column bottom and undergoes a flash in the tank D104 provided with steam reboilers (E104A e B).

The steam phase of the D104 is sent to the following extractive distillation section (C201).

The solvent with the residual C_4 is sent to the stripping column C102, where Butadiene and acetylenics flow out from the top, and the solvent from the bottom. After releasing

the heat in the exchangers E102A and B, E302, E305, E110A and B and E109, the solvent returns to the initial tank D501.

The C102 is provided with a steam reboiler (E107) used to strip the C_4 completely from the solvent.

The top products of the C102 are partly condensed in the exchangers E105, operating as heat recuperator of the condensate circuit, and in the E106 operating with the tower water.

The condensed liquid, collected in the D102, is partly refluxed to the C102 and partly sent to the exchanger E108.

The steam-operated exchanger E108 is used to degas the solvent before sending it to the solvent purification section (C401). The gas flowing out of the E108 returns to the exchanger E106.

The non-condensed gas in the exchangers E105 and E106 flows through the D102 and is sucked by the two-phase process compressor P101. Then, it is partly conveyed to the bottom of the column C101B and partly to the following extractive distillation section (C201).

The above mentioned compressor is provided with an intermediate exchanger (E111) and with a condensate collection tank D105.

1.1.2 SECOND EXTRACTIVE DISTILLATION

In this section the butadiene is separated from most of the acetylenics contained in the flow coming from the initial extractive distillation section (P101 e D104).

The C_4 steams flow into the column C201 where they meet the cool countercurrent solvent coming from the tank D501 which favors the separation of the vinylacetylene from the other components.

The steams flowing out of the column top C201, essentially composed of Butadiene, are condensed in the exchanger E201 and the liquid, collected in the tank D201 (raw butadiene), is partly refluxed and partly fed in the following rectification section (C301).

Three exchangers are used to heat up the column C201. The exchangers E203/S are steam-operated, while the E202 recovers the heat of the column bottom flux.

The solvent, rich in hydrocarbons, which flows out of the bottom C201 after releasing the heat to the E202 as described above, is sent to E208 and from there to the column C202 where it undergoes an initial stripping process with the heat supplied by the steam-operated reboiler E204.

The steams outflowing from the column C202 are sucked back to the process compressor through the exchanger E106.

The liquid at the bottom of the column C202, composed of solvent and acetylenics, flows to the second stripping column C203 where the acetylenics flow out from the top and the warm solvent, stripped from the C_4, flows out from the bottom. The warm solvent then joins the solvent outflowing from the C102 bottom to perform the already described cooling off cycle.

The C203 is heated by a bottom steam reboiler (E207).

The top steams of the C203, partly condense in the exchangers E205 (heat recuperator for the condensate circuit) and E206, which is operated with cooling water.

The condensed liquid is collected in the tank D202, partly refluxed in the column and partly sent to the solvent purification section (C401).

The gases sucked from D202 along with those of the C401 and those coming from the D301 (the off-gases), are sent with the pumping system D509-P501-D510.

The blower P501 is provided with a heat exchanger (E501).

1.1.3 BUTADIENE RECTIFICATION

The raw Butadiene resulting from the second extractive distillation (D201) is purified by the lighter and heavier hydrocarbons and sent to stock.

The raw butadiene resulting from the D201 is fed in the C301. The methyl acetylene flows out from the column top diluted with Butadiene while the raw butadiene, containing heavy hydrocarbons, flows out from the column bottom.

The column top steams are partly condensed in the exchanger E301. The liquid is collected in the D301 and then refluxed in the column while the residual gas is sent to the separator D509 -D510.

A reboiler (E302) operating with warm solvent and placed at the bottom of the column is used to obtain the above described separation.

The Butadiene outflowing from the bottom of the column C301 is fed in the column C302. Pure Butadiene steams flow out from the top C302. These are condensed in the exchanger E303, collected in the tank D302, and partly refluxed in the column and partly sent to stock after the cooling off process in the exchanger E309.

The separation of the Butadiene from the heavy products is obtained through the heat supplied by two reboilers installed at the bottom of the column: one operated with warm condensate (E304) and one operated with warm solvent (E305).

To prevent the butadiene polymer formation, p-terbutylcathecol (TBC) is sent to the top of the rectification column (C301 e C302) and to the finished product.

1.1.4 SOLVENT PURIFICATION

The solvent coming from the exchanger E108, from the tank D202 and possibly from the process draining collection tank D506, is fed in the column C401, where, at its top, water and dimer (4-Vinylcycle-esyn) and, at its bottom, purified solvent are separated. This is then sent to the tank D402 after the cooling off process in the exchanger E403 operated with tower-water.

After the condensation process in E401, the top steams are collected in D401.

The water is partly refluxed through the column and partly disposed of. The dimer, collected in a part of the D401, is sent to the D403.

The column C401 is heated by the steam-operated E402.

A small quantity of warm cycle solvent coming from the bottom of the strippers C102 and C203 is sent to the steam-operated evaporator E405 to separate the solvent from the heavy polymeric products (TAR).

This operation is performed by keeping the device under vacuum through a steam ejector whose discharge is condensed with tower water in the exchanger E410.

The solvent flows out as steam from the E405, it is condensed in the exchanger E404 and collected in the tank D402 together with the bottom solvent C401, finally it is recirculated through the fluxing system of the pump seals.

The polymeric products (TAR) remained in the bottom of the exchanger E405 are discharged in the D403 as toluene-diluted tarry products.

1.1.5 ADDITIVES

The section includes small additive stock tanks used for diverse process requirements and tanks for the additive blending with diluents which favor their pumping.

The tank D502 contains furfurol.

The tank D503 contains high density silicon oil used as defoamer.

Toluene is stored in the tank D504

Sodium nitrite is put in the tank D507.

p-terbutylcathecol (TBC) is charged in the tank D508.

THE CONDENSATE HEADER

The condensates of the steam consumed in the unit are collected in the tank D505. Through a circuit, they recover the heat from the exchangers E105, E205 and E208 as described above.

1.1.6 DRAINING AND FLARE HEADER

The waste gas from the plant are connected to the site network through the separator D511 provided with a condensate exchanger for the C_4 liquid evaporation.

The gas stage of the D506 (tank for the collection of process draining) is connected to the D511 so that all the discharges of the safety valves and the equipment draining are conveyed into these two tanks.

The D506 is provided with a pump in C401 or E405 for the processing of the solvent contained in it or for the direct recovery of the solvent in D501.