The mass flow of the individual components (sulfur, nitrogen, saturated compounds, monoaromatics, diaromatics, triaromatics, rapeseed oil) entering the reactor were calculated from the mass flow of the feedstocks and their composition according to **Equation (Eq.) S1**.

$$m_i^F = m^F \cdot w_i^F \tag{S1}$$

where m_i^F is the mass flow of the *i* component in the feedstock (g·h^{-1}), m^F is the mass flow of the feedstock in g·h^{-1} and w_i^F is the mass fraction of the *i* component in the feedstock.

The mass flow of the individual components contained in the stabilised liquid products were calculated according to **Eq. S2**.

$$m_i^P = m^P \cdot w_i^P \tag{S2}$$

where m_i^P is the mass flow of *i* component contained in the stabilised liquid products in g·h^{-1}, m^P is the mass flow of the liquid product in g·h^{-1} and w_i^P is the mass fraction of *i* component in the liquid product.

The hydrogen consumption for the hydrogenation of the double bonds in the rapeseed oil ($m_{H_{DB}}$) in g·h^{-1} was calculated according to **Eq. S3**.

$$m_{H_{DB}} = m_{RO}^{F20} \cdot A_{RO} \cdot \frac{M_{H_2}}{M_{RO}} \tag{S3}$$

where m_{RO}^{F20} is the mass flow of the rapeseed oil (RO) in the feedstock containing 20 wt% of RO (F20) in g·h^{-1}, A_{RO} is the average number of the double bonds in 1 molecule of the RO, M_{H_2} is the molar mass of the hydrogen molecule and M_{RO} is the average molar mass of the RO, both in g·mol^{-1}.

The average number of the double bonds in the RO (A_{RO}) was calculated according to **Eq. S4**.

$$A_{RO} = 3 \cdot (x_{Ac16}^1 + x_{Ac18}^1 + 2 \cdot x_{Ac18}^2 + 3 \cdot x_{Ac18}^3 + x_{Ac20}^1 + x_{Ac22}^1 + x_{Ac24}^1) \tag{S4}$$

where x_{Ac16}^1 is the molar fraction of the acyl with 16 carbon atoms and one double bond in the RO molecule (C16:1 acyl) relative to all the RO acyls. Similarly, x_{Ac18}^1, x_{Ac18}^2, x_{Ac18}^3, x_{Ac20}^1, x_{Ac22}^1 and x_{Ac24}^1 are the molar fractions of the C18:1, C18:2, C18:3, C20:1, C22:1 and C24:1 acyls, respectively.

The average molar mass of the rapeseed oil (M_{RO}) was calculated according to **Eq. S5**.

$$M_{RO} = 3 \cdot M_C + 5 \cdot M_H + 3 \cdot \sum(x_{Aci} \cdot (C_i \cdot M_C + H_i \cdot M_H + 2 \cdot M_O)) \tag{S5}$$

where C_i and H_i are the numbers of the carbon and hydrogen atoms in the *i* acyl, respectively, x_{Aci} is the molar fraction of the *i* acyl, M_C, M_H and M_O are the molar masses of the carbon, hydrogen and oxygen atoms in g·mol^{-1}, respectively.

The n-alkanes contained in the petroleum feedstock are practically unchanged during the hydrotreating. The n-alkane content in the stabilised products of the hydrotreating F0 feedstock was available only for the WHSV of 1.0 h^{-1}. For a WHSV of 0.5, 1.5 and 2.0 h^{-1}, the n-alkane content in the stabilised products of the hydrotreating F0 feedstock was assumed to be the same, therefore, their mass flow was proportional to the WHSV used. The mass flow of the n-alkanes originating from the RO conversion was, therefore, calculated from the mass flow of n-alkanes contained in the hydrotreating product of the F20 feedstock from which the mass flow of the n-alkanes originating from the petroleum part of the feedstock were subtracted according to **Eq. S6**.

$$m_{A_i}^{RO} = m_{A_i}^{P20} - (1 - w_{RO}^{F20}) \cdot m_{A_i}^{P0} \cdot \frac{WHSV^{F20}}{WHSV^{F0}} \tag{S6}$$

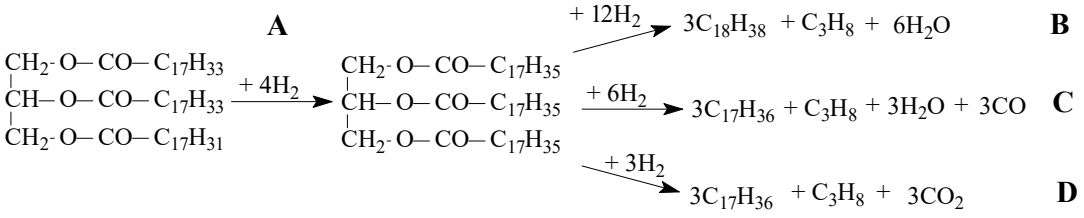
where $m_{A_i}^{RO}$ is the mass flow of the *i* n-alkane that originated from the RO in g·h^{-1}, $m_{A_i}^{P20}$ is the mass flow of the *i* n-alkane in the product from the hydrotreating of the F20 feedstock in g·h^{-1}, $m_{A_i}^{P0}$ is the mass flow of the *i* n-alkane in the product from the hydrotreating of the F0 feedstock at similar temperature, w_{RO}^{F20} is the mass fraction of the RO in the F20 feedstock and $WHSV^{F20}$ and $WHSV^{F0}$ are the weight hourly space velocities used in the hydrotreating of the F20 and F0 feedstocks, respectively.

The C_{18} acyls, which form the major part of the RO acyls, provide the C_{18} n-alkane at the HDO reaction and the C_{17} n-alkane at the HDCx and HDCn reactions. The share of the HDO reaction in the RO conversion (A_{HDO}) was, therefore, calculated according to **Eq. S7**. It was assumed that the C_{14}, C_{16}, C_{20}, C_{22}, and C_{24} acyls contained in the RO were converted into odd-numbered alkanes and even-numbered alkanes in the same ratio as the C_{18} acyls.

$$A_{HDO} = \frac{n_{A_{18}}^{RO}}{(n_{A_{18}}^{RO} + n_{A_{17}}^{RO})} = \frac{\frac{m_{A_{18}}^{RO}}{M_{A_{18}}}}{(\frac{m_{A_{18}}^{RO}}{M_{A_{18}}} + \frac{m_{A_{17}}^{RO}}{M_{A_{17}}})} \quad \text{(S7)}$$

where $n_{A_{18}}^{RO}$ and $n_{A_{17}}^{RO}$ are the molar flows of the C_{18} and C_{17} n-alkanes arising from the RO hydrotreating in mol·h^{-1}, respectively, $m_{A_{18}}^{RO}$ and $m_{A_{17}}^{RO}$ are the mass flows of the C_{18} and C_{17} n-alkanes arising from the RO hydrotreating in g·h^{-1}, respectively, $M_{A_{18}}$ and $M_{A_{17}}$ are the molar masses of the C_{18} n-alkane and C_{17} n-alkane in g·mol^{-1}, respectively.

12 moles of hydrogen (H_2) were consumed on the HDO of the RO (**Eq. S8-B**) whose double bonds in the acyls have been saturated (**Eq. S8-A**). The hydrogen consumption for the RO HDO ($m_{H_{HDO}}$) in g·h^{-1} was calculated according to **Eq. S9**.



(S8)

$$m_{H_{HDO}} = m_{RO}^{F20} \cdot A_{HDO} \cdot \frac{12 \cdot M_{H_2}}{M_{RO}} \quad \text{(S9)}$$

Carbon monoxide is much more strongly adsorbed on alumina than CO_2, therefore, the methanation of CO_2 in the presence of CO almost does not take place [1–3]. The amount of methane resulting from the methanation (m_{Me}^{Met}) in g·h^{-1} was calculated according to **Eq. S10**.

$$m_{Me}^{Met} = m_{Me}^{P20} - m_{Me}^{P0} \quad \text{(S10)}$$

where m_{Me}^{P20} and m_{Me}^{P0} are the mass flows of the methane in the gaseous product from the hydrotreating of the F20 and F0 feedstocks gained at a similar reaction temperature in g·h^{-1}, respectively. The calculation is based on the assumption that the mass flow of methane formed by hydrocracking both feedstocks is the same at a similar reaction temperature and independent to the WHSV used. As the WHSV increases, the amount of feedstock that can be cracked to methane increases, while the residence time of the feedstock on the catalyst decreases, leading to a decrease in the cracking. The overall result of these opposing influences is that the mass flow of the light hydrocarbons from the hydrocracking does not significantly depend on the WHSV. This is consistent with the results published by Palanisamy et al.[29] It was found[29] that the amount of the cracked products originated from the hydrotreating of light gas oil on an NiMo/Al_2O_3 catalyst decreased from 7 wt% to 3 wt% as the WHSV increased from 0.75 h^{-1} to 1.5 h^{-1}.

The mass flows of methane in the gaseous product from the hydrotreating of the F20 and F0 feedstocks (m_{Me}^{P20} and m_{Me}^{P0}, respectively) were calculated according to **Eq. S11** and **S12**, respectively.

$$m_{Me}^{P20} = V^{P20} \cdot \Phi_{Me}^{P20} \cdot \frac{M_{Me}}{V_{Me}^{M}} \quad \text{(S11)}$$

$$m_{Me}^{P0} = V^{P0} \cdot \Phi_{Me}^{P0} \cdot \frac{M_{Me}}{V_{Me}^{M}} \quad \text{(S12)}$$

where V_{Me}^{M} is the methane molar volume at 20 °C in dm^3·mol^{-1}, M_{Me} is the molar mass of methane in g·mol^{-1}, V^{P20} and V^{P0} are the volume flows of the gaseous products from the hydrotreating of the F20 and F0 feedstocks in dm^3·h^{-1}, respectively, and Φ_{Me}^{P20} and Φ_{Me}^{P0} are the volume fractions of the methane in the P20 and P0 gaseous products, respectively.

The hydrogen consumption for the methanation ($m_{H_{Me}}$) in g·h^{-1} was calculated according to **Eq. S13** on the assumption that 3 moles of hydrogen are used for methanation of 1 mole of CO (**Eq. 2**).

$$m_{H_{Me}} = m_{Me}^{Met} \cdot \frac{3 \cdot M_{H_2}}{M_{Me}} \tag{S13}$$

3 moles of hydrogen (H_2) were consumed on the HDCx of the RO (**Eq. S8-D**) whose double bonds in the acyls have been saturated (**Eq. S8-A**). The hydrogen consumption for the RO hydrodecarboxylation ($m_{H_{HDCx}}$) in g·h^{-1} was, therefore, calculated according to **Eq. S14**.

$$m_{H_{HDCx}} = m_{RO}^{F20} \cdot A_{HDCx} \cdot \frac{3 \cdot M_{H_2}}{M_{RO}} \tag{S14}$$

where A_{HDCx} is the share of the HDCx reaction in the RO conversion calculated from the molar flows of the C_{18} and C_{17} n-alkanes resulting from the RO conversion in mol·h^{-1} ($n_{A_{18}}^{RO}$ and $n_{A_{18}}^{RO}$, respectively) and the molar flows of the CO (n_{CO}^{RO}) and CO_2 ($n_{CO_2}^{RO}$) resulting from the RO conversion in mol·h^{-1} according to **Eq. S15**.

$$A_{HDCx} = \frac{n_{A_{17}}^{RO}}{n_{A_{17}}^{RO} + n_{A_{18}}^{RO}} \cdot \frac{n_{CO_2}^{RO}}{n_{CO_2}^{RO} + n_{CO}^{RO}} = (1 - A_{HDO}) \cdot \frac{n_{CO_2}^{RO}}{n_{CO_2}^{RO} + n_{CO}^{RO}} \tag{S15}$$

The molar flow of CO_2 in mol·h^{-1} was calculated according to **Eq. S16**. The methanation of CO_2 and the possible reduction of CO_2 with hydrogen to CO and water (reverse water gas-shift reaction) were neglected.

$$n_{CO_2}^{RO} = n_{CO_2}^{P20} = V^{P20} \cdot \frac{\phi_{CO_2}}{V_{CO_2}^{M}} \tag{S16}$$

where $n_{CO_2}^{P20}$ is the molar flow of CO_2 in the gaseous products from the hydrotreating F20 feedstock in mol·h^{-1}, ϕ_{CO_2} is the volume fraction of CO_2 in the gaseous products from the hydrotreating and $V_{CO_2}^{M}$ is the molar volume of CO_2 at 20 °C in dm^3·mol^{-1}.

Part of the CO generated by the hydrodecarbonylation of the RO was converted to methane. The molar flow of the CO resulting from the RO conversion in mol·h^{-1} was, therefore, calculated according to **Eq. S17** from the molar flow of the CO in the gaseous products of the hydrotreating of the F20 feedstock in mol·h^{-1} (n_{CO}^{P20}) and the molar flow of the CO that was converted to methane in mol·h^{-1} (n_{CO}^{Met}).

$$n_{CO}^{RO} = n_{CO}^{P20} + n_{CO}^{Met} \tag{S17}$$

The molar flow of the CO in the gaseous products from the hydrotreating F20 feedstock (n_{CO}^{P20}) was calculated according to **Eq. S18**.

$$n_{CO}^{P20} = V^{P20} \cdot \frac{\phi_{CO}}{V_{CO}^{M}} \tag{S18}$$

where ϕ_{CO} is the volume fraction of the CO in the gaseous products from the hydrotreating F20 feedstock and V_{CO}^{M} is the molar volume of the CO at 20 °C in dm^3·mol^{-1}.

The molar flow of the CO that was converted to methane (n_{CO}^{Met}) is the same as the molar flow of the methane formed by methanation of the CO (n_{Me}^{Met}), because a mole of CO gives 1 mole of methane. The molar flow of CO that was converted to methane was, therefore, calculated according to **Eq. S19**.

$$n_{CO}^{Met} = n_{Me}^{Met} = \frac{m_{Me}^{Met}}{M_{Me}} \tag{S19}$$

where m_{Me}^{Met} is the mass flow of the methane from the methanation in g·h^{-1} that was calculated according to **Eq. 13** and M_{Me} is the molar mass of the methane in g·mol^{-1}.

6 moles of hydrogen (H_2) were consumed on the HDCn of the RO (**Eq. S8-C**) whose double bonds in the acyls have been saturated (**Eq. S8-A**). The hydrogen consumption for the RO hydrodecarbonylation ($m_{H_{HDCn}}$) in $g \cdot h^{-1}$ was calculated according to **Eq. S20**.

$$m_{H_{HDCn}} = m_{RO}^{F20} \cdot A_{HDCn} \cdot \frac{6 \cdot M_{H_2}}{M_{RO}} \quad \text{(S20)}$$

where A_{HDCn} is the share of the HDCn reaction in the RO conversion.

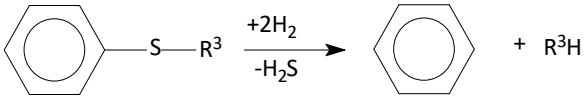
At the full conversion of the RO to hydrocarbons, **Eq. S21** can be used for the A_{HDCn} calculation.

$$A_{HDCn} = (1 - A_{HDO} - A_{HDCx}) \quad \text{(S21)}$$

If CO is not formed by the HDCn reaction, but it is produced by the reduction of CO_2 with hydrogen,[7,8] the hydrogen consumption will be the same as the hydrogen consumption calculated for the RO hydrodecarbonylation. HDCn of 1 mole of saturated triglyceride consumes 6 moles of hydrogen. In the HDCx of 1 mole of saturated triglyceride, 3 moles of hydrogen are consumed and 3 moles of CO_2 are formed. Another 3 moles of hydrogen are then use to convert 3 moles of CO_2 to CO (**Eq. 1**), so 6 moles of hydrogen are consumed in total in the HDCx pathway.

In middle petroleum distillates, sulfur is mainly found in the form of alkyl benzothiophenes and alkyl dibenzothiophenes. Thiofenes, sulfides, disulfides naphtobenzothiophenes and thiols are also present in minor amounts [4,5]. Two moles of hydrogen (H_2) are needed [6-9] for the HDS of alkyl sulfides (**Eq. S22**) and aryl sulfides (**Eq. S23**), direct and indirect HDS of alkyl thiophenes (**Eq. S24-A, S24-D**), alkyl benzothiophenes (**Eq. S25-A, S25-D**), alkyl dibenzothiophenes (**Eq. S26-A, S26-D**) and alkyl naphtobenzothiophenes (**Eq. S27-A, S27-D**), unless the hydrogenation of the double bonds or benzene rings in these compounds is considered. The hydrogen consumption for the hydrogenation of the unsaturated bonds resulting from the direct HDS (**Eq. S24-B, S25-B**) and eventual hydrogenation of the aromatic rings (**Eq. S26-C, S27-C**), which occurs during the indirect HDS of the alkyl thiophenes, alkyl benzothiophenes, alkyl dibenzothiophenes and alkyl naphtobenzothiophenes, is reflected in the group-type composition changes. Therefore, it was not included in the hydrogen consumption for the HDS, but in the hydrogen consumption for the hydrodearomatisation (HDA). 3 and 1 moles of molecular hydrogen are needed for HDS of disulfides (**Eq. S28**) and thiols (**Eq. S29**) for which 3 and 1 moles of molecular hydrogen are needed for their HDS, respectively.

(S22)



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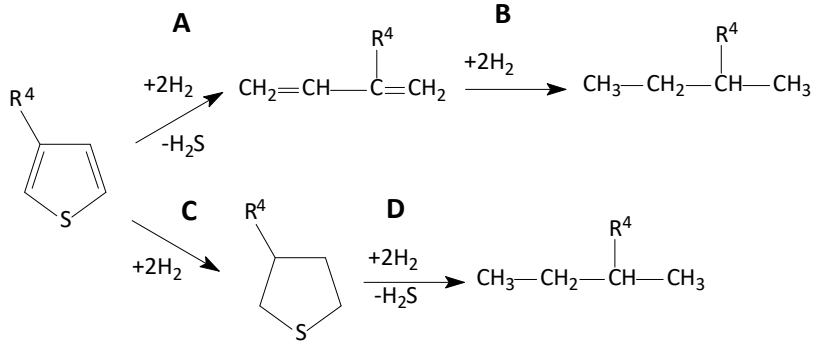

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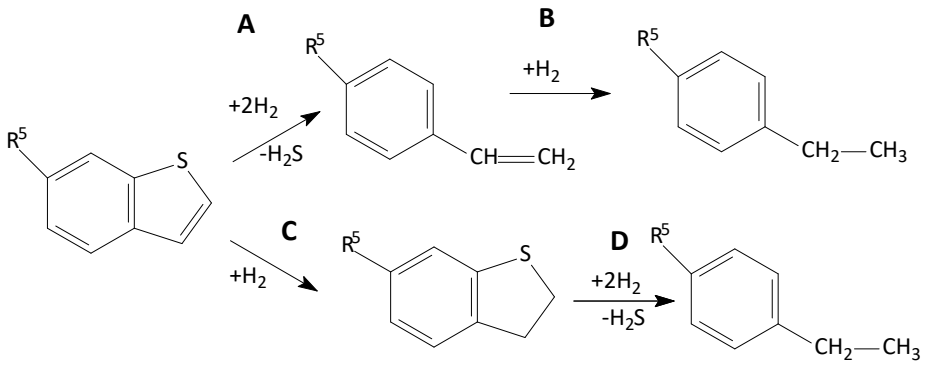

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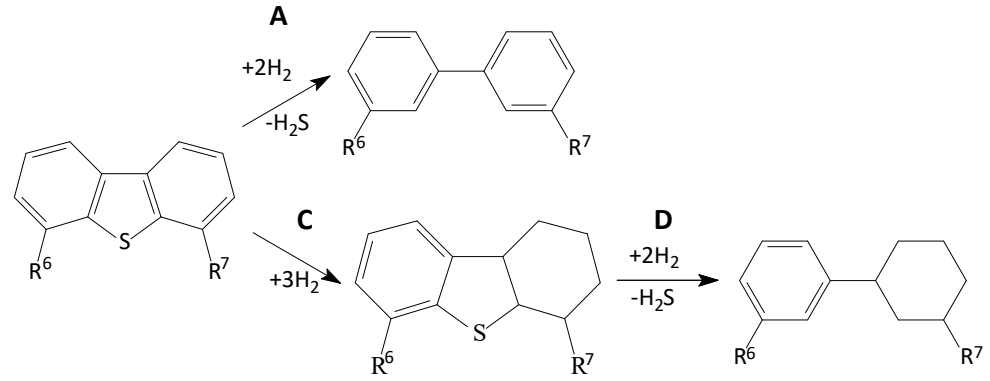

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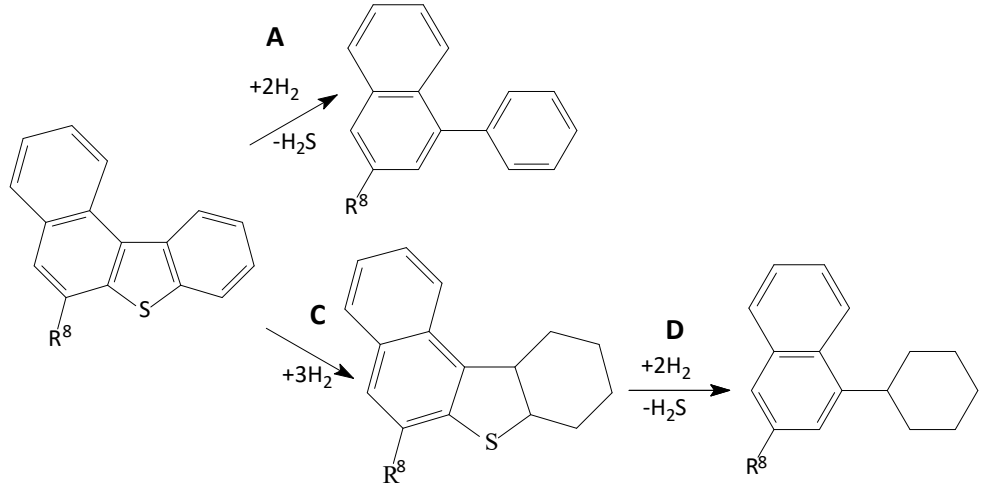

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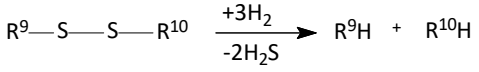

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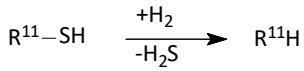


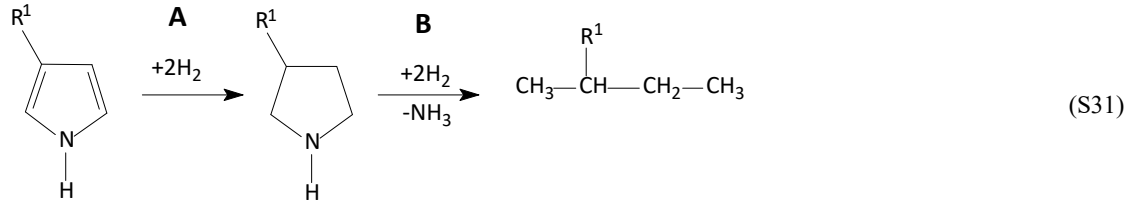
(S29)

The hydrogen consumption for the hydrodesulfurisation (HDS) of the feedstock ($m_{H_{HDS}}$) in g·h^{-1} was calculated according to **Eq. S30**. In view of the above reactions, the calculation was performed with the estimation that 2 moles of molecular hydrogen were consumed on average per 1 mole of sulfur in the feedstock.

$$m_{H_{HDS}} = (m_S^F - m_S^P) \cdot \frac{2 \cdot M_{H_2}}{M_S} \quad \text{(S30)}$$

where m_S^F and m_S^P are the mass flows of the sulfur in the feedstock and the appropriate liquid product in g·h^{-1}, respectively, and M_S is the molar mass of sulfur in g·mol^{-1}.

In middle petroleum distillates, nitrogen is mainly found in the form of alkyl pyrroles, alkyl indoles, alkyl carbazoles alkyl pyridines, alkyl quinolines, alkyl benzoquinolines, alkyl acridines, alkyl amines and aryl amines [10–15]. Two moles of hydrogen are consumed for the HDN of the alkyl pyrroles (**Eq. S31-B**), alkyl indoles (**Eq. S32-B**) and alkyl carbazoles (**Eq. S33-B**), unless the hydrogenation of the double bonds in these compounds is considered (**Eq. S31-A, S32-A, S33-A**). One mole of hydrogen is consumed for the HDN of the alkyl amines (**Eq. S34**) and aryl amines (**Eq. S35**). Two moles of hydrogen are needed for the HDN of the alkyl pyridines (**Eq. S36-B**), alkyl quinolines (**Eq. S37-B**), alkyl benzoquinolines (**Eq. S38-B**) and alkyl acridines (**Eq. S39-B**), unless the hydrogenation of the double bonds is considered. The hydrogen consumption for the hydrogenation of the double bonds (**Eq. S31-A, S32-A, S33-A, S36-A, S37-A, S38-A, S39-A**) and eventual hydrogenation of the aromatic rings of the nitrogen compounds, which occurs during the HDN of some nitrogen compounds, have an impact on the changes in the group-type composition, therefore, it was included in the hydrogen consumption for the HDA.



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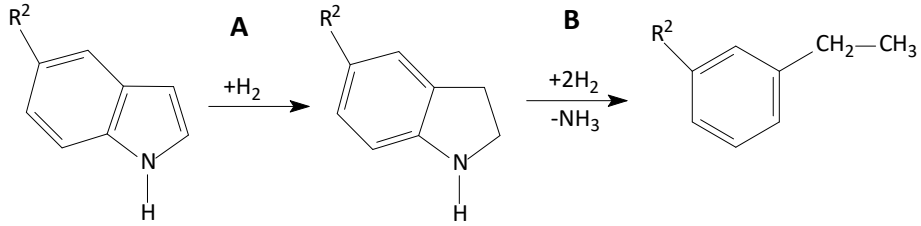

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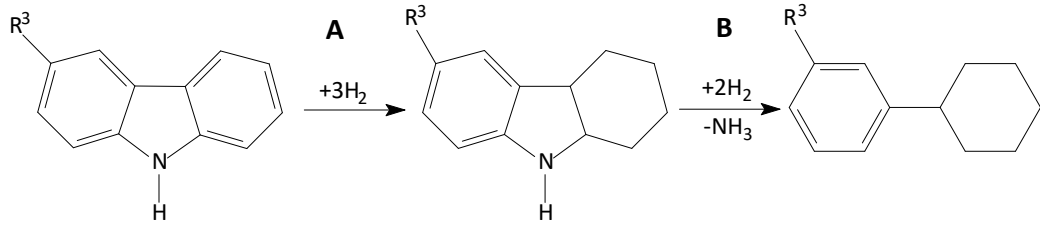

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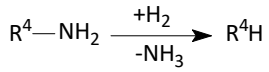

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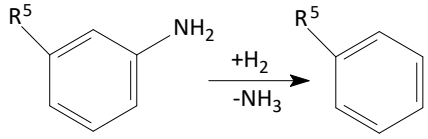

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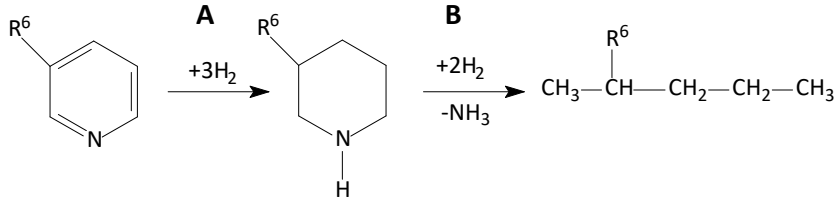

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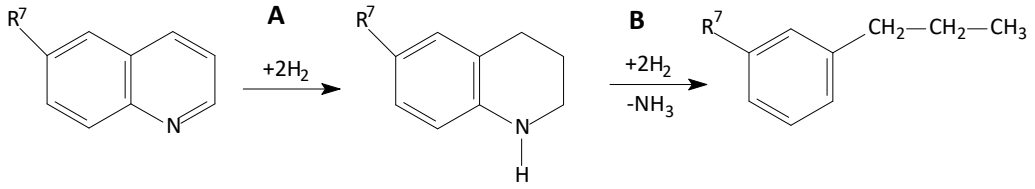

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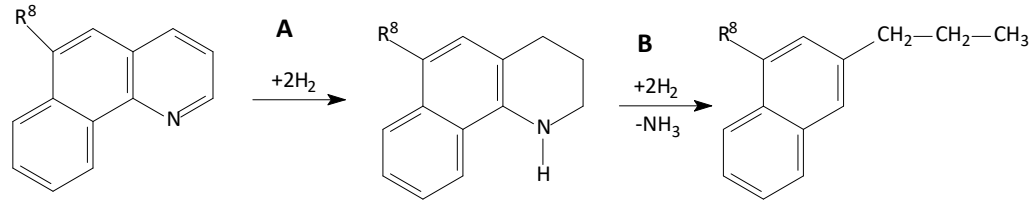

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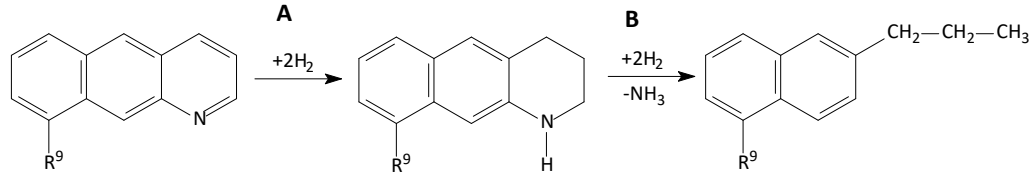

(S39)

The hydrogen consumption for the hydrodenitrogenation (HDN) of the feedstock ($m_{H_{HDN}}$) in g·h^{-1} was calculated according to **Eq. S40**. In view of the above reactions, the calculation was performed with the estimation that 2 moles of hydrogen were consumed on average per 1 mole of nitrogen in the feedstock.

$$m_{H_{HDN}} = (m_N^F - m_N^P) \cdot \frac{2 \cdot M_{H_2}}{M_N} \tag{S40}$$

where m_N^F and m_N^P are the mass flows of the nitrogen in the F0 or F20 feedstock and the appropriate product in g·h^{-1}, respectively, and M_N is the molar mass of the nitrogen atom in g·mol^{-1}.

The calculation of the hydrogen consumption for the hydrodearomatisation (HDA) was performed using model compounds whose boiling points are in the range of 300–330 °C, which corresponds to the mean boiling point of the F0 feedstock (315 °C). The hydrogen consumption for the HDA of the feedstock ($m_{H_{HDA}}$) in g·h^{-1} was calculated according to **Eq. S41**.

$$m_{H_{HDA}} = m_{H_{HDA}}^{TA} + m_{H_{HDA}}^{DA} + m_{H_{HDA}}^{MA} \tag{S41}$$

where $m_{H_{HDA}}^{TA}$, $m_{H_{HDA}}^{DA}$, and $m_{H_{HDA}}^{MA}$ are the hydrogen consumptions to convert triaromatics to diaromatics, diaromatics to monoaromatics, and the monoaromatics to saturated compounds in g·h^{-1}, respectively.

The hydrogen consumption for the conversion of the triaromatics to diaromatics was calculated according to **Eq. S42**.

$$m_{H_{HDA}}^{TA} = (m_{TA}^F - m_{TA}^P) \cdot \frac{2 \cdot M_{H_2}}{M_{TA}^{ST}} \tag{S42}$$

where M_{TA}^{ST} is the molar mass of phenanthrene (m_{TA}^{ST}=178 g·mol^{-1}) which was chosen as the triaromatic standard for the calculation, m_{TA}^F and m_{TA}^P are the mass flows of the triaromatics in the feedstocks and the stabilised products in g·h^{-1}, respectively.

The amount of triaromatics removed by the HDA (m_{TA}^{Re}) is approximately equal to the amount of diaromatics formed from them in g·h^{-1} (m_{DA}^{TA}) (**Eq. S43**). The conversion of triaromatics into diaromatics has to be taken into account during the calculating of hydrogen consumption for the conversion of diaromatics into monoaromatics ($m_{H_{HDA}}^{DA}$), which was calculated according to **Eq. S44**.

$$m_{DA}^{TA} \cong m_{TA}^{Re} = m_{TA}^F - m_{TA}^P \tag{S43}$$

$$m_{H_{HDA}}^{DA} = (m_{DA}^F + m_{DA}^{TA} - m_{DA}^P) \cdot \frac{2 \cdot M_{H_2}}{M_{DA}^{ST}} \tag{S44}$$

where M_{DA}^{ST} is the molar mass of the hexyl naphthalene (m_{DA}^{ST}=212 g·mol^{-1}) which was chosen as the diaromatic standard for the calculation, m_{DA}^{F} and m_{DA}^{P} are the mass flows of the diaromatics in the feedstock and the stabilised products in g·h^{-1}, respectively.

The amount of monoaromatics formed by the hydrogenation of the diaromatics (m_{MA}^{DA}) is approximately equal to the amount of diaromatics removed during the hydrotreating (m_{DA}^{Re}) in g·h^{-1} (**Eq. S45**). The conversion of diaromatics into monoaromatics has to be taken into account during the calculating of the hydrogen consumption for the conversion of monoaromatics to saturated hydrocarbons ($m_{H_{HDA}}^{MA}$) which was calculated according to **Eq. S46**.

$$m_{MA}^{DA} \cong m_{DA}^{Re} = m_{DA}^{F} + m_{DA}^{TA} - m_{DA}^{P} \quad \text{(S45)}$$

$$m_{H_{HDA}}^{MA} = (m_{MA}^{F} + m_{MA}^{DA} - m_{MA}^{P}) \cdot \frac{3 \cdot M_{H_2}}{M_{MA}^{ST}} \quad \text{(S46)}$$

where M_{MA}^{ST} is the molar mass of C_{12} alkyl benzene (m_{MA}^{ST}=246 g·mol^{-1}) which was chosen as the monoaromatic standard for the calculation, m_{MA}^{F} and m_{MA}^{P} are the mass flows of the monoaromatics in the feedstock and the stabilised products in g·h^{-1}, respectively.

The hydrogen consumption for the hydrotreating of the RO ($m_{H_{RO}}$) and the petroleum part of the feedstock ($m_{H_{PF}}$), both in g·h^{-1}, was calculated according to **Eq. S47** and **S48**, respectively.

$$m_{H_{RO}} = m_{H_{DB}} + m_{H_{HDO}} + m_{H_{HDCx}} + m_{H_{HDCn}} \quad \text{(S47)}$$

$$m_{H_{PF}} = m_{H_{HDS}} + m_{H_{HDN}} + m_{H_{HDA}}^{TA} + m_{H_{HDA}}^{DA} + m_{H_{HDA}}^{MA} \quad \text{(S48)}$$

The total hydrogen consumption for the hydrotreating of the whole feedstock (m_{H_T}) in g·h^{-1} was calculated according to **Eq. S49**. The hydrogen consumption for the feedstock cracking, the hydrogenation of the alkenes (if they were present in a small amount) and the reverse water-gas-shift reactions was neglected.

$$m_{H_T} = m_{H_{PF}} + m_{H_{RO}} + m_{H_{Me}} \quad \text{(S49)}$$

where $m_{H_{Me}}$ is the hydrogen consumption for the methanation in g·h^{-1} that was calculated according to **Eq. S13**.

the excess of hydrogen relative to its consumption (Ex_H) was calculated according to **Eq. S50**.

$$Ex_H = m_H^F / m_{H_T} \quad \text{(S50)}$$

where m_H^F is the hydrogen mass flow used for the hydrotreating in g·h^{-1}.

The total volume of the hydrogen consumption related to 1 m^3 of the feedstock ($V_{H_T}^{RF}$) in m^3·m^{-3} was calculated according to **Eq. S51**.

$$V_{H_T}^{RF} = m_{H_T} \cdot V_{H_2}^{M} / (M_{H_2} \cdot V^F) \quad \text{(S51)}$$

where $V_{H_2}^{M}$ is the hydrogen molar volume at 20 °C in dm^3·mol^{-1}, M_{H_2} is the hydrogen (H_2) molar mass in g·mol^{-1}, and V^F is the feedstock volume flow in dm^3·h^{-1}.

Similarly, the volume of the hydrogen consumed on the HDS, HDN, HDA, HDO, HDCn, HDCx, methanation of the CO and hydrogenation of the double bonds in the RO related to 1 m^3 of the feedstock in m^3·m^{-3} ($V_{H_{HDS}}^{RF}$, $V_{H_{HDN}}^{RF}$ $V_{H_{HDA}}^{RF}$, $V_{H_{HDO}}^{RF}$, $V_{H_{HDCn}}^{RF}$, $V_{H_{HDCx}}^{RF}$, $V_{H_{Me}}^{RF}$, and $V_{H_{DB}}^{RF}$ respectively) was calculated according to **Eq. S52–S59**.

$$V_{H_{HDS}}^{RF} = m_{H_{HDS}} \cdot V_{H_2}^{M} / (M_{H_2} \cdot V^F) \quad \text{(S52)}$$

$$V_{H_{HDN}}^{RF} = m_{H_{HDN}} \cdot V_{H_2}^{M} / (M_{H_2} \cdot V^F) \quad \text{(S53)}$$

$$V_{H_{HDA}}^{RF} = m_{H_{HDA}} \cdot V_{H_2}^{M} / (M_{H_2} \cdot V^F) \quad \text{(S54)}$$

$$V_{H_{HDO}}^{RF} = m_{H_{HDO}} \cdot V_{H_2}^{M} / (M_{H_2} \cdot V^F) \quad \text{(S55)}$$

$$V_{H_{HDCn}}^{RF} = m_{H_{HDCn}} \cdot V_{H_2}^{M}/(M_{H_2} \cdot V^F) \quad \text{(S56)}$$

$$V_{H_{HDCx}}^{RF} = m_{H_{HDCx}} \cdot V_{H_2}^{M}/(M_{H_2} \cdot V^F) \quad \text{(S57)}$$

$$V_{H_{Me}}^{RF} = m_{H_{Me}} \cdot V_{H_2}^{M}/(M_{H_2} \cdot V^F) \quad \text{(S58)}$$

$$V_{H_{DB}}^{RF} = m_{H_{DB}} \cdot V_{H_2}^{M}/(M_{H_2} \cdot V^F) \quad \text{(S59)}$$

Nomenclature

A_{HDCn}	The share of the HDCn reaction in the RO conversion
A_{HDCx}	The share of the HDCx reaction in the RO conversion
A_{HDO}	The share of the HDO reaction in the RO conversion
A_{RO}	the average number of the double bonds in 1 molecule of RO
CFPP	cold filter plugging point, °C
C_i	the numbers of carbon atoms in the *i* acyl
Ex_H	the excess of hydrogen relative to its consumption
HDA	Hydrodearomatisation
HDCn	Hydrodecarbonylation
HDCx	Hydrodecarboxylation
HDN	Hydrodenitrogenation
HDO	Hydrodeoxygenation
HDS	hydrodesulfurisation
HEFA	hydroprocessed esters and fatty acids
H_i	the numbers of hydrogen atoms in the *i* acyl
$m_{A_{17}}^{RO}$	the mass flows of the C_{17} n-alkane arising from the RO hydrotreating, g·h^{-1}
$m_{A_{18}}^{RO}$	the mass flows of the C_{18} n-alkane arising from the RO hydrotreating, g·h^{-1}
$m_{A_i}^{P0}$	the mass flow of the *i* n alkane in the product from the hydrotreating of the F0 feedstock, g·h^{-1}
$m_{A_i}^{P20}$	the mass flow of the *i* n alkane in the product from the hydrotreating of the F20 feedstock, g·h^{-1}
$m_{A_i}^{RO}$	the mass flow of the *i* n alkane that originated from the RO, g·h^{-1}
m^F	the mass flow of the feedstock, g·h^{-1}
$m_{H_{DB}}$	The hydrogen consumption for the hydrogenation of the double bonds in the RO, g·h^{-1}
$m_{H_{HDA}}$	the hydrogen consumption for the HDA of the feedstock, g·h^{-1}
$m_{H_{HDA}}^{DA}$	the hydrogen consumptions to convert the diaromatics to monoaromatics, g·h^{-1}
$m_{H_{HDA}}^{MA}$	the hydrogen consumptions to convert the monoaromatics to saturated compounds, g·h^{-1}
$m_{H_{HDA}}^{TA}$	the hydrogen consumptions to convert the triaromatics to diaromatics, g·h^{-1}
$m_{H_{HDCn}}$	the hydrogen consumption for the RO hydrodecarbonylation, g·h^{-1}
$m_{H_{HDCx}}$	the hydrogen consumption for the RO hydrodecarboxylation, g·h^{-1}
$m_{H_{HDN}}$	the hydrogen consumption for the hydrodenitrogenation of the feedstock, g·h^{-1}
$m_{H_{HDO}}$	the hydrogen consumption for the RO hydrodeoxygenation, g·h^{-1}
$m_{H_{HDS}}$	the hydrogen consumption for the hydrodesulfurisation of the feedstock, g·h^{-1}
$m_{H_{Me}}$	the hydrogen consumption for the methanation, g·h^{-1}
$m_{H_{PF}}$	the hydrogen consumption for the hydrotreating of the petroleum part of the feedstock, g·h^{-1}
$m_{H_{RO}}$	the hydrogen consumption for the hydrotreating of the RO, g·h^{-1}
m_{H_T}	the total hydrogen consumption for the hydrotreating of the whole feedstock, g·h^{-1}
m_{DA}^F	the mass flow of the diaromatics in the feedstock, g·h^{-1}
m_{DA}^P	the mass flow of the diaromatics in the stabilised product, g·h^{-1}
m_{DA}^{Re}	the amount of diaromatics removed during the hydrotreating, g·h^{-1}
m_{DA}^{TA}	to the amount of diaromatics formed from triaromatics, g·h^{-1}
m_H^F	the hydrogen mass flow used for the hydrotreating, g·h^{-1}
m_i^F	the mass flow of the *i* component in the feedstock, g·h^{-1}
m_i^P	the mass flow of *i* component contained in the stabilised liquid products, g·h^{-1}

m_{MA}^{DA}	the amount of monoaromatics formed by the hydrogenation of the diaromatics, g·h^{-1}
m_{MA}^{F}	the mass flow of the monoaromatics in the feedstock, g·h^{-1}
m_{MA}^{P}	the mass flow of the monoaromatics in the stabilised product, g·h^{-1}
m_{Me}^{Met}	the mass flow of the methane from methanation, g·h^{-1}
m_{Me}^{P0}	the mass flow of the methane in the gaseous product from the hydrotreating of the F0 feedstock, g·h^{-1}
m_{Me}^{P20}	the mass flow of the methane in the gaseous product from the hydrotreating of the F20 feedstock, g·h^{-1}
m_{N}^{F}	the mass flow of the nitrogen in the F0 or F20 feedstock, g·h^{-1}
m_{N}^{P}	the mass flow of the nitrogen in the stabilised product, g·h^{-1}
m^{P}	the mass flow of the stabilised product, g·h^{-1}
m_{RO}^{F20}	the mass flow of RO in the F20 feedstock, g·h^{-1}
m_{S}^{F}	the mass flow of the sulfur in the feedstock, g·h^{-1}
m_{S}^{P}	the mass flow of the sulfur in the stabilised product, g·h^{-1}
m_{TA}^{F}	the mass flow of the triaromatics in the feedstock, g·h^{-1}
m_{TA}^{P}	the mass flow of the triaromatics in the stabilised product, g·h^{-1}
m_{TA}^{Re}	the amount of triaromatics removed by the HDA, g·h^{-1}
$M_{A_{17}}$	the molar mass of C_{17} n alkane, g·mol^{-1}
$M_{A_{18}}$	the molar mass of C_{18} n alkane, g·mol^{-1}
M_{C}	the molar mass of carbon, g·mol^{-1}
M_{DA}^{ST}	the molar mass of the diaromatics standard (hexyl naphthalene), g·mol^{-1}
M_{H}	the molar mass of atomic hydrogen, g·mol^{-1}
M_{H_2}	the molar mass of hydrogen molecule (H_2), g·mol^{-1}
M_{MA}^{ST}	the molar mass of the monoaromatics standard (C_{12} alkyl benzene), g·mol^{-1}
M_{Me}	the molar mass of methane, g·mol^{-1}
M_{N}	the molar mass of atomic nitrogen, g·mol^{-1}
M_{O}	the molar mass of atomic oxygen, g·mol^{-1}
M_{RO}	the average molar mass of the RO, g·mol^{-1}
M_{S}	the molar mass of sulfur, g·mol^{-1}
M_{TA}^{ST}	the molar mass of the triaromatics standard (phenanthrene), g·mol^{-1}
$n_{A_{17}}^{RO}$	the molar flow of the C_{17} n-alkane resulting from the RO conversion, mol·h^{-1}
$n_{A_{18}}^{RO}$	the molar flow of the C_{18} n-alkane resulting from the RO conversion, mol·h^{-1}
n_{CO}^{Met}	the molar flow of CO that was converted to methane, mol·h^{-1}
n_{CO}^{P20}	the molar flow of CO in gaseous products from the hydrotreating of the F20 feedstock, mol·h^{-1}
n_{CO}^{RO}	the molar flow of the CO resulting from RO conversion, mol·h^{-1}
$n_{CO_2}^{P20}$	the molar flow of CO_2 in gaseous products from hydrotreating F20 feedstock, mol·h^{-1}
$n_{CO_2}^{RO}$	the molar flow of the CO_2 resulting from RO conversion, mol·h^{-1}
n_{Me}^{Met}	the molar flow of the methane formed by methanation of CO, mol·h^{-1}
RO	rapeseed oil
SRGO	straight run gas-oil
V^{F}	the volume flow of the feedstock, dm^3·h^{-1}
V^{P0}	the volume flow of the gaseous product from the hydrotreating of the F0 feedstock, dm^3·h^{-1}
V^{P20}	the volume flow of the gaseous product from the hydrotreating of the F20 feedstock, dm^3·h^{-1}
V_{CO}^{M}	the molar volume of CO at 20 °C, dm^3·mol^{-1}
$V_{CO_2}^{M}$	the molar volume of CO_2 at 20 °C, dm^3·mol^{-1}
$V_{H_2}^{M}$	the molar volume of hydrogen at 20 °C, dm^3·mol^{-1}
V_{Me}^{M}	the molar volume of methane at 20 °C, dm^3·mol^{-1}
$V_{H_{DB}}^{RF}$	the volume of hydrogen consumed for hydrogenation of the double bonds in RO related to 1 m^3 of the feedstock, m^3·m^{-3}
$V_{H_{HDA}}^{RF}$	the volume of hydrogen consumed for HDA related to 1 m^3 of the feedstock, m^3·m^{-3}
$V_{H_{HDCn}}^{RF}$	the volume of hydrogen consumed for HDCn of RO related to 1 m^3 of the feedstock, m^3·m^{-3}

$V_{H_{HDCx}}^{RF}$	the volume of hydrogen consumed for HDCx of RO related to 1 m^3 of the feedstock, $m^3 \cdot m^{-3}$
$V_{H_{HDO}}^{RF}$	the volume of hydrogen consumed for HDO of RO related to 1 m^3 of the feedstock, $m^3 \cdot m^{-3}$
$V_{H_{HDN}}^{RF}$	the volume of hydrogen consumed for HDN related to 1 m^3 of the feedstock, $m^3 \cdot m^{-3}$
$V_{H_{HDS}}^{RF}$	the volume of hydrogen consumed for HDS related to 1 m^3 of the feedstock, $m^3 \cdot m^{-3}$
$V_{H_{Me}}^{RF}$	the volume of hydrogen consumed for methanation of CO related to 1 m^3 of the feedstock, $m^3 \cdot m^{-3}$
$V_{H_T}^{RF}$	the total volume of hydrogen consumption related to 1 m^3 of the feedstock, $m^3 \cdot m^{-3}$
w_i^F	the mass fraction of the *i* component in the feedstock
w_i^P	the mass fraction of the *i* component in the stabilised liquid product
w_{RO}^{F20}	the mass fraction of RO in the F20 feedstock
WHSV	weight hourly space velocity, h^{-1}
$WHSV^{F0}$	weight hourly space velocity of the hydrotreating of the F0 feedstock, h^{-1}
$WHSV^{F20}$	weight hourly space velocity of the hydrotreating of the F20 feedstock, h^{-1}
x_{Aci}	the molar fraction of the *i* acyl
x_{Ac16}^1	the molar fraction of the acyl with 16 carbon atoms and one double bond in the RO molecule
x_{Ac18}^1	the molar fraction of the acyl with 18 carbon atoms and one double bond in the RO molecule
x_{Ac18}^2	the molar fraction of the acyl with 18 carbon atoms and two double bonds in the RO molecule
x_{Ac18}^3	the molar fraction of the acyl with 18 carbon atoms and tree double bonds in the RO molecule
x_{Ac20}^1	the molar fraction of the acyl with 20 carbon atoms and one double bond in the RO molecule
x_{Ac22}^1	the molar fraction of the acyl with 22 carbon atoms and one double bond in the RO molecule
x_{Ac24}^1	the molar fraction of the acyl with 24 carbon atoms and one double bond in the RO molecule
Φ_{CO}	the volume fraction of CO in gaseous products from the hydrotreating
Φ_{CO_2}	the volume fraction of CO_2 in gaseous products from the hydrotreating
Φ_{Me}^{P0}	the volume fraction of the methane in the P0 gaseous product
Φ_{Me}^{P20}	the volume fraction of the methane in the P20 gaseous product

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