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UTJECAJ HIDROOBRADE FCC SIROVINE NA PRINOSE I KAKVOĆU PRODUKATA KREKIRANJA

Sažetak

U radu je ispitan utjecaj hidroobrade FCC sirovine na prinose produkata katalitičkog krekiranja. Praćeni su prinosi frakcija benzina, ukapljenog naftnog plina (UNP) i cikličkog ulja te vrijednosti oktanskog broja i sadržaja sumpora u frakcijama benzina. Istraživanja su provedena na HDS/BHK i FCC procesima u INA-Rafineriji nafte Rijeka.

Rezultati provedenih istraživanja pokazali su da se hidroobradom sirovine za katalitički kreking utječe na povećanje prinosa frakcija benzina i UNP-a, uz smanjenje prinosa lakog cikličkog ulja. Također, primjenom hidroobrađene sirovine postiže se niži sadržaj sumpora, kao i niže vrijednosti oktanskog broja benzina. Ovaj posljednji, nepoželjni utjecaj, vezan je prvenstveno uz konverziju aromatskih ugljikovodika u naftenske u procesu hidroobrade sirovine za katalitički kreking.

1.Uvod

Temeljni problemi proizvodnje naftnih goriva vezani su uz sve strože ekološke zahtjeve, kao što su sadržaj sumpora i aromatskih ugljikovodika. U sklopu rafinerijske prerade, vezano uz spomenute zahtjeve, posebna je pozornost upućena na procese katalitičkog krekiranja (FCC) i hidrodesulfurizacije (HDS) plinskih ulja. Dok FCC benzini i ciklička ulja predstavljaju glavne izvore sumpora u motornim gorivima, HDS je proces koji ga učinkovito uklanja, poboljšavajući pritom kakvoću produkata sa stajališta stabilnosti, boje, mirisa i drugih značajki.

Proces katalitičkog krekinga uključuje različite konverzije ugljikovodika visokog vrelišta s ciljem dobivanja produkata nižeg vrelišta i većih komercijalnih vrijednosti. U prisutnosti fluidiziranih zeolitnih katalizatora u procesu se odvija veći broj endotermnih (krekiranje, dehidrogenacija, dealkilacija) i egzotermnih (prijelaz vodika, izomerizacija) reakcija, čija zastupljenost utječe na prinose i sastav produkata[1-13]. Ona je pak ovisna o fizikalno-kemijskim značajkama katalizatora i sirovina te većem broju zavisnih i nezavisnih procesnih varijabli [13-18]. Vakuum plinska ulja primjenjuju se kao standardne sirovine, a dodavanje manjih količina destilacijskih ostataka uvjetuje složenost ugljikovodičnog sastava, povećavajući zahtjeve vezane uz katalitičku stabilnost.

Ovisno o primijenjenoj sirovini, produkte katalitičkog krekinga (benzini, ciklička ulja) karakterizira visoki sadržaj sumpora. Smatra se da FCC benzin doprinosi ukupnom sadržaju sumpora u motornim benzinima s visokim udjelom čak do 98 %. Također, zakonski propisana ograničenja sadržaja aromatskih ugljikovodika postavljaju zahtjeve na proces katalitičkog krekinga u smislu oštrine procesnih uvjeta, kao i primijenjenog katalizatora. U cilju rješavanja navedenih problema kao logičan pristup nameće se potreba za hidroobradom sirovina i/ili produkata katalitičkog krekinga. Osim značajnog smanjenja sadržaja sumpora, procesima hidroobrade postižu se također i poželjne konverzije ugljikovodika, koje rezultiraju nižim sadržajem aromata u produktima katalitičkog krekiranja, tj. i boljim ekološkim značajkama goriva [19-21].

2. Postrojenje HDS / BHK

Postrojenje za hidrodesulfurizaciju plinskog ulja i blagi hidrokreking (HDS / BHK) u Rafineriji nafte Rijeka može raditi u dva moda, HDS (hidrodesulfurizacija) i BHK (blagi hidrokreking), koristeći vodik s postrojenja reforminga benzina.

Procesi HDS i BHK su katalitički, te koriste krute katalizatore na osnovi alumine (Al_2O_3) na koju se nanose aktivni metali, Ni i Mo, u obliku sulfida. Katalizatori se nalaze u dva serijski vezana reaktora. Postrojenje radi pri tlaku od 70 bar, te pri temperaturama u reaktorima od 330 – 410℃.

U HDS modu postrojenje se koristi za hidrodesulfurizaciju plinskih ulja. Šarža postrojenja u ovom modu rada uključuje lako plinsko ulje s postrojenja atmosferske destilacije, krekirano lako plinsko ulje s postrojenja visbreakinga, te lako cikličko ulje s postrojenja FCC. Glavnina šarže je lako plinsko ulje s atmosferske destilacije, dok krekirana laka plinska ulja predstavljaju manji udio u šarži, oko 10 – 15 % m/m.

Glavni produkt postrojenja HDS je desulfurizirano plinsko ulje koje se koristi za namješavanje niskosumpornih dizelskih goriva i loživih ulja.

U BHK (eng. MHC, mild hydrocracking) modu postrojenje se koristi za blagi hidrokreking vakuum plinskog ulja s postrojenja vakuumske destilacije i teškog plinskog ulja s postrojenja atmosferske destilacije. Ovim procesom dolazi do hidrodesulfurizacije vakuum plinskog i teškog plinskog ulja, te do hidrokrekinga dijela vakuum plinskih i teškog plinskog ulja u lakše komponente, BHK lako plinsko ulje i teški benzin, koje se koriste za namješavanja niskosumpornih dizelskih goriva, odnosno benzina. Glavni produkt postrojenja BHK je hidrodesulfurizirano vakuum plinsko ulje (BHK ostatak) koje se koristi kao niskosumporna (hidroobrađena) šarža za postrojenje FCC, iz koje se proizvodi niskosumporni FCC benzin, kao komponenta za namješavanje niskosumpornog motornog benzina.

3. Eksperimentalni dio

3.1. FCC proces

Za praćenje rada procesa katalitičkog krekiranja (FCC) korištene su prosječne vrijednosti podataka za razdoblje od četiri dana rada s nehidroobrađenom sirovinom (razdoblje 1), te za razdoblje od četiri dana s hidroobrađenom sirovinom (razdoblje 2).

Tablica 1: Fizikalne i kemijske značajke sirovina

Sirovina	HIDROOBRAĐENA	NEHIDROOBRAĐENA
Watson faktor, K	12,1	11,8
Gustoća (15°C), g/cm^3	0,8866	0,9065
Sumpor, % m/m	0,0195	1,18
Viskoznost (100°C), mm^2/s	6,01	7,12
Indeks refrakcije (70°C)	1,4780	1,4874
Conradson ugljik, % m/m	0,11	0,40

Tablica 2: Fizikalna i kemijska svojstva svježeg i ravnotežnog katalizatora

SVJEŽI KATALIZATOR	
CORAL 753 + Resolve 7( )	
Kemijska svojstva	
Al_2O_3, % m/m	44,1
Na, % m/m	0,29
RE_2O_3, % m/m	2,7
Fizička svojstva	
Raspodjela veličine čestica	
<149 μ	95%
<105μ	76%
<80μ	53%
<40μ	12%
<20μ	1%
Prosječna veličina čestica, μm	77
Specifična površina ,m^2/g	329
Nasipna gustoća, kg/m^3	721
Prosjek dodavanja katalizatora, kg/d	1200

RAVNOTEŽNI KAT.	
Kemijska svojstva	
AL_2O_3, % m/m	44,2
RE_2O_3, % m/m	2,76
Na, % m/m	0,29
Fe, % m/m	0,32
Ugljik, % m/m	0,04
Ni, ppm	1528
V, ppm	1353
Fizička svojstva	
Raspodjela veličine čestica	
<105μ	71%
<80μ	40%
<60μ	11%
<40μ	0%
Prosječna veličina čestica, μm	87
Specifična površina, m^2/g	124
Nasipna gustoća, kg/m^3	850
Aktivnost, %wt	70

Sirovine: Vakuum plinsko ulje (nehidroobrađena – NHT sirovina) i BHK ostatak (hidroobrađena – HT sirovina). Fizikalno-kemijske značajke prikazane su u tablici 1.

Katalizator: Komercijalni, zeolitnog tipa (Coral 753 + Resolve 700). Fizikalne i kemijske značajke prikazane su u tablici 2.

Procesni uvjeti: Temperatura predgrijanja sirovine 233℃, temperatu ra uzlazne cijevi (riser) 535℃, C/O=7.0

3.2. BHK proces

Za praćenje rada BHK procesa na kojemu je dobivena sirovina za FCC proces (BHK ostatak) korištene su prosječne vrijednosti podataka za dva razdoblja rada od četiri dana, pri različitim procesnim uvjetima.

Sirovina: Vakuum plinska ulja + teško plinsko ulje s atmosferske destilacije. Fizikalno-kemijske značajke prikazane su u tablici 3.

Tablica 3: Fizikalne i kemijske značajke sirovine

Sirovina		**1**	**2**
Gustoća	kg/m^3	890,95	894,53
Sumpor	% m/m	1,0125	1,1233

Procesni uvjeti: prikazani u tablici 4.

Tablica 4: Parametri BHK procesa za različitu oštrinu rada

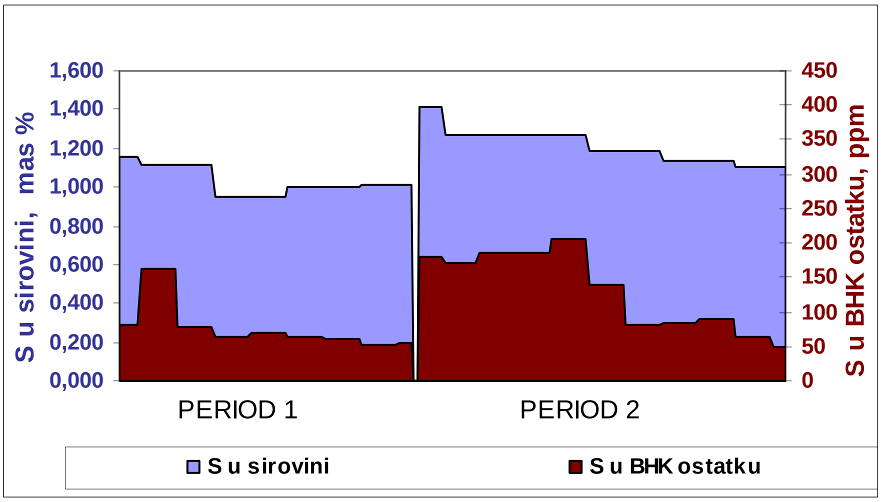
BHK		**NAČIN RADA**	
		1	**2**
Temperatura ulaza u 26 R-1	℃	375	379
Temperatura ulaza u 26 R-2	℃	381	386
WABT*	℃	382	388
Tlak u VT sustavu	bar g	55	55
ppH_2	bar a	54	55
«Make-up» plin	kg/h	2875	2733
Kemijska potrošnja H_2	Nm^3 H_2/m^3	47,3	40,3

*Weighted average bed temperature

4. Rezultati i rasprava

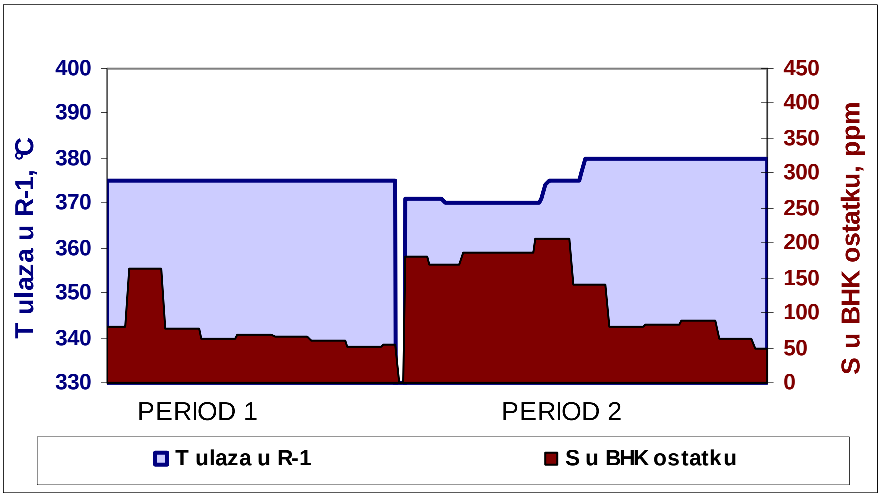
U radu je ispitan utjecaj hidroobrade sirovine na raspodjelu produkata procesa katalitičkog krekiranja (FCC). Primijenjene su dvije sirovine, pri čemu je prva standardna (vakuum plinska ulja), a druga je ta ista sirovina podvrgnuta procesu blagog hidrokrekiranja (BHK) pri različitim uvjetima rada (tablica 1).

Slika 1: Sadržaj sumpora u sirovini / BHK ostatku
Figure 1: Sulphur content in the feed/MHC residue



/S in the feed, S in the MHC residue/

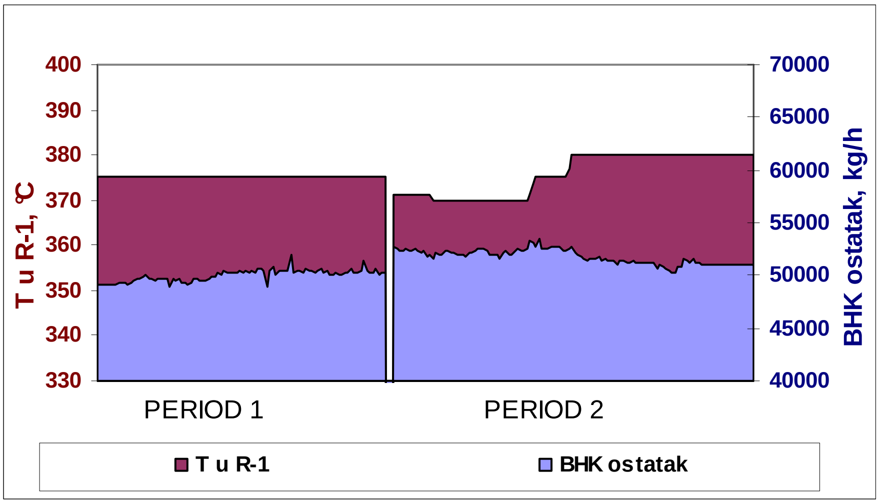
Slika 2: Odnos temperature ulaza u reaktor R-1 i sadržaja sumpora u BHK ostatku
Figure 2: Ratio between input temperature in reactor R-1 and sulphur content in the MHC residue



/Input T at R-1, S in MHC residue/

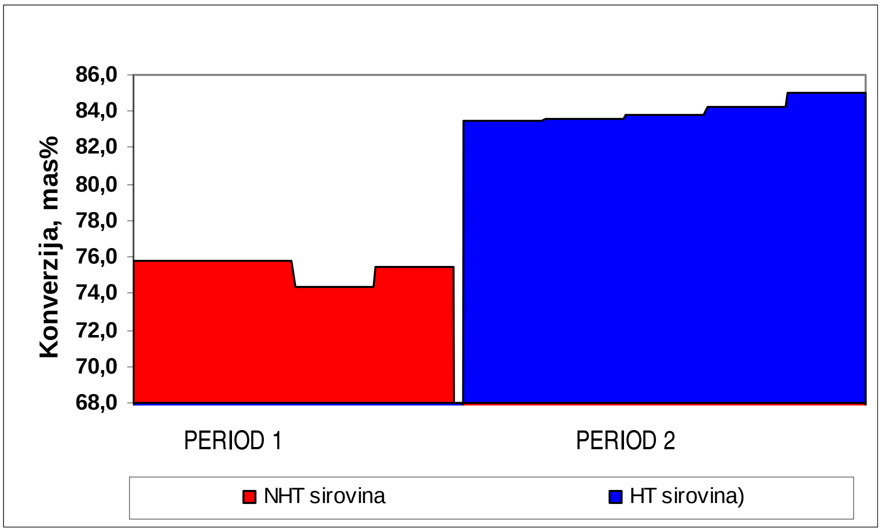
Rezultati na slici 1 pokazuju promjenu sadržaja sumpora u sirovini kao i u ostatku BHK procesa u ovisnosti o načinu rada (razdoblje 1 i razdoblje 2).

Slika 3: Iscrpak BHK ostatka u odnosu na temperaturu ulaza u reaktor R-1
Slika 3: Yield of MHC residue with regard to input temperatura at reactor R-1



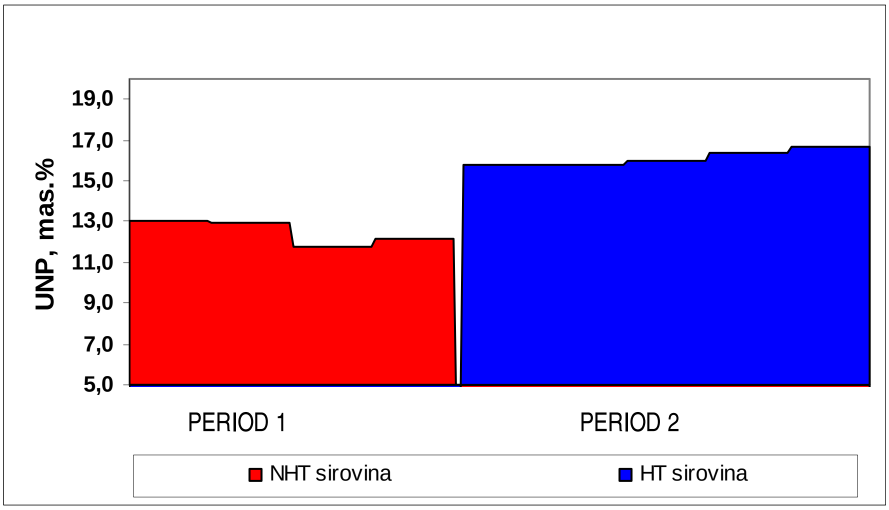
/T at R-1, MHC residue/

Slika 4: Ovisnost konverzije u FCC procesu o značajkama sirovine
Figure 4: Dependence of conversion in the FCC process on feed properties



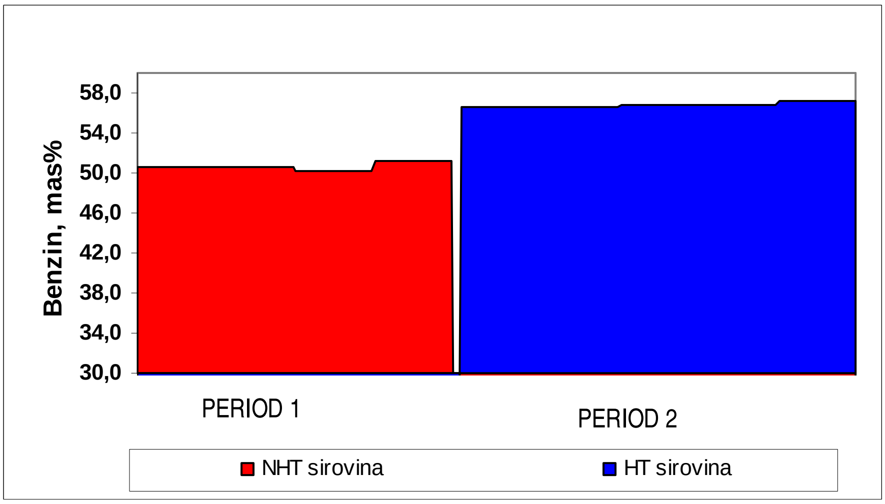
/Conversion, UHT feed, HT feed/

Slika 5: Ovisnost prinosa UNP u FCC procesu o značajkama sirovine
Figure 5: Dependence of the yield of LNG in the FCC process on feed properties



/LNG, UHT feed, HT feed/

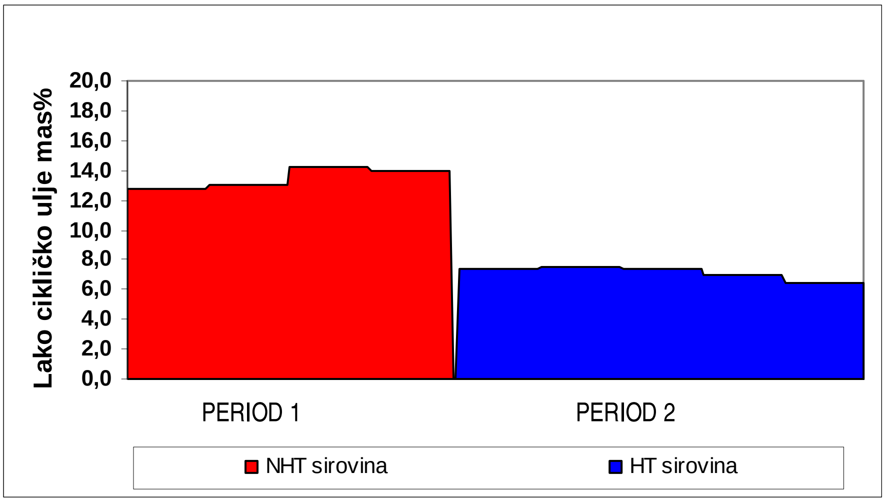
Slika 6: Ovisnost prinosa FCC benzina o značajkama sirovine
Figure 6: Dependence of the FCC gasoline yield on feed properties



/Gasoline, UHT feed, HT feed/

Rezultati na slici 2 prikazuju utjecaj temperature ulazne sirovine u reaktor R-1 na sadržaj sumpora u BHK ostatku. Vidljiv je značajan utjecaj temperature kao procesnog parametra, čijim povećanjem se smanjuje sadržaj sumpora, što je osobito vidljivo pri najvišoj temperaturi ulazne sirovine (kraj razdoblja 2).
Smanjenje temperature u reaktorima uvjetuje povećanje iscrpka BHK ostatka s obzirom da se smanjenjem temperature u reaktorima smanjuje udjel reakcija hidrokrekiranja, čime se smanjuju prinosi produkata nižeg vrelišta, kao što su frakcije benzina i plinskog ulja (slika 3).

Slika 7: Ovisnost prinosa LCU u FCC procesu o značajkama sirovine
Figure 7: Dependence of the LCO yield in the FCC process on feed properties



/Light cyclic oil, UHT feed, HT feed/

Poznato je da se procesom hidroobrade sirovine za katalitički kreking povećava sposobnost krekiranja, što je vidljivo iz raspodjele produkata FCC procesa, dobivene za hidroobrađenu i nehidroobrađenu sirovinu. Rezultati na slici 4 pokazuju veće postignute konverzije primjenom hidroobrađene sirovine, čime je potvrđena veća sklonost krekiranju sirovina parafinskog tipa (K=12.1), kakva je dobivena procesom BHK. U skladu s navedenim postignuti su viši prinosi frakcija ukapljenog naftnog plina (UNP) i benzina, te niži prinosi lakog cikličkog ulja (LCU) za hidroobrađenu sirovinu, što je prikazano na slikama 5, 6 i 7.

S obzirom na veliku zastupljenost reakcija hidrogenacije u promatranom području temperatura i ostalih uvjeta procesa BHK, uočljive su promjene sastava kao i oktanskog broja FCC benzina. Primjenom hidroobrađene sirovine opaženo je smanjenje sadržaja olefina i aromata kao i povećanje udjela ugljikovodika parafinskog tipa. Ove promjene u sastavu FCC benzina uvjetovale su smanjenje vrijednosti istraživačkog (IOB) i čak malo povećanje motornog oktanskog broja (MOB), što je vidljivo iz rezultata u tablici 5. Navedeno smanjenje istraživačkog oktanskog broja benzina, uvjetovano hidroobradom FCC sirovine moguće je kompenzirati izborom procesnih uvjeta katalitičkog krekinga koji će utjecati na povećanje udjela izoparafina u FCC benzinu, dok je nešto povećan MOB povoljan s obzirom na oktanski "pool" INE.

Tablica 5: Kakvoća FCC benzina u ovisnosti o značajkama sirovine

FCC BENZIN	SIROVINA	
	HIDROOBRAĐENA	NEHIDROOBRAĐENA
IOB	91,63	93,1
MOB	81,00	80,7
Sumpor, % m/m	0,0013	0,0775
Olefini, % v/v	20,67	36,66
Aromati, % v/v	23,84	25,17
Parafini+Nafteni, % v/v	55,49	38,17
Bromni broj	35,9	73,00
Kraj destilacije, °C	201	204

5. Zaključak

Rezultati provedenih istraživanja pokazali su da se hidroobradom sirovine za katalitički kreking procesom BHK utječe na povećanje konverzije te prinosa frakcija benzina i ukapljenog naftnog plina, uz smanjenje prinosa lakog cikličkog ulja. Primjenom hidroobrađene sirovine postignuto je povećanje prinosa ukapljenog naftnog plina (UNP) za 4-5 % m/m uz povećanje prinosa frakcije benzina za oko 8 % m/m. Istodobno, utvrđeno je smanjenje vrijednosti oktanskog broja benzina (IOB) za hidroobrađenu sirovinu, što je nepoželjni utjecaj procesa hidroobrade sirovine za katalitički kreking.

Procesom BHK sirovine za katalitički kreking smanjen je sadržaj sumpora s 1.18 % m/m na 0.0195 % m/m. Primjenom hidroobrađene sirovine u FCC procesu postignut je vrlo nizak sadržaj sumpora od 0.0013 % m/m u benzinu, u odnosu na sadržaj sumpora od 0.0775 % m/m u istoj frakciji dobivenoj krekiranjem nehidroobrađene sirovine.

FCC benzin dobiven primjenom hidroobrađene sirovine koristi se kao komponenta za namješavanje pri proizvodnji niskosumpornih benzina europske kvalitete, dok je primjena visokosumpornog FCC benzina isključivo u proizvodnji benzina za tržišta na kojima se mogu prodati benzini s višim i visokim sadržajem sumpora.

THE IMPACT OF FCC FEED HYDROTREATMENT ON THE YIELDS AND QUALITY OF CRACKING PRODUCTS

Abstract

The paper investigates the impact of FCC feed hydrotreatment on the yield of catalytic cracking products. Monitored were the yields of gasoline fractions, LPG and cyclic oil, and the values of octane number and sulphur content in gasoline fractions. Research was performed at the HDS/MHC and FCC processes at INA Rafinerija nafte Rijeka.

The results of the research conducted have shown that the hydrotreatment of the catalytic cracking feed impacts an increase in the yield of gasoline and LPG fractions, with a reduced yield of light cyclic oil. Also, the application of hydrotreated feed achieves a lower sulphur content, as well as lower values of the gasoline octane number. The latter, unwanted effect, is associated primarily with the conversion of aromatic hydrocarbons into naphthenic in the hydrotreatment process of the catalytic cracking feed.

1. Introduction

The basic problems in the production of oil fuels are associated with growingly stringent environmental requirements, such as the content of sulphur and aromatic hydrocarbons. In the scope of refinery processing, regarding the above mentioned requirements, special attention has been paid to the processes of catalytic cracking (FCC) and hydrodesulfurization (HDS) of gas oils. While FCC gasolines and cyclic oils represent the main sources of sulphur in motor fuels, HDS is a process which efficiently removes it, improving the quality of products from the viewpoint of stability, colour, odour and other properties.

The process of catalytic cracking involves various conversions of high boiling point hydrocarbons with the purpose of obtaining products with lower boiling point and higher commercial values. In the presence of fluidzed zeolite catalysts, the process involves a large number of endothermal (cracking, dehydrogenation, dealkylation) and exothermal (hydrogen transfer, isomerization) reactions, whose occurence impacts the yield and composition of products[1-13]. It is in turn dependent on the physico-chemical properties of catalysts and feeds, as well as a larger number of both dependent and independent process variables [13-18]. Vacuum gas oils are applied as standard feeds, while the addition of lower quantities of distillate residues conditions the complexity of hydrocarbon composition, increasing requirements associated with catalytic stability.

Depending on the feed applied, the products of catalytic cracking (gasoline, cyclic oils) are characterized by a high sulphur content. It is considered that FCC gasoline contributes to total sulphur content in motor gasoline with a high share of up to 98%. Also, legally prescribed limitations of the aromatic hydrocarbons content impose certain expectations on the process of catalytic cracking in terms of the severity of process conditions, as well as the catalyst applied. For the purpose of solving the above problems, as a logical approach, comes the need for the hydrotreatment of feeds and/or products of catalytic cracking. Apart from a considerable reduction of the sulphur content, the processes of hydrotreatment also achieve desirable conversions of hydrocarbons, resulting in lower aromatics content in the products of catalytic cracking, which means improved environmental properties of the fuel[19-21].

2. HDS/MHC plant

The plant for the hydrodesulfurization of gas oil and mild hydrocracking (HDS/MHC) at the Oil Refinery in Rijeka is capable of operating in two modes, HDS (hydrodesulfurization) and MHC (mild hydrocracking), using hydrogen from the gasoline reforming plant.

The HDS and MHC processes are catalytic, using solid catalysts on the basis of alumina (Al_2O_3) on which active metals, Ni and Mo are coated, in the form of sulfides. The catalysts are in two reactors connected in series. The plant operates at the pressure of 70 bar, and at temperatures in the reactors of 330 – 410℃.

In HDS mode the plant is used for the hydrodesulfurization of gas oils. The plant charge in this operation mode includes light gas oil from the atmospheric distillation plant, cracked light gas oil from the visbreaking plant, and light cyclic oil from the FCC plant. The charge mainly consists of light gas oil from the atmospheric distillation plant, while cracked light gas oils have a smaller share in the charge, around 10 – 15 mas%.

The main product of the HDS plant is desulfurized gas oil used for the blending of low-sulphur diesel fuels and fuel oils.

In the MHC mode, the plant is used for mild hydrocracking of vacuum gas oil from the vacuum distillation plant and heavy gas oil from the atmospheric distillation plant. This process leads to the hydrodesulfurization of vacuum gas and heavy gas oil, and to the hydrocracking of a part of vacuum gas and heavy gas oil into lighter components, MHC light gas oil and heavy gasoline, used for the blending of low sulphur diesel fuels i.e. gasoline. The main product of the MHC plant is the hydrodesulfurized vacuum gas oil (MHC residue) which is used as low sulphur (hydrotreated) charge for the FCC plant, out of which low sulphur FCC gasoline is produced, as component for blending low sulphur motor gasoline.

3. Experimental part

3.1. The FCC Process

For monitoring the operation of the process of catalytic cracking (FCC) used were the average values of data for the period of four days' work with unhydrotreated feed (period 1), and for the period of four days with hydrotreated feed (period 2).

Table 1: Physico-chemical properties of the feeds

Feed	HYDROTREATED	UNHYDROTREATED
Watson factor, K	12,1	11,8
Density (15℃), g/cm^3	0,8866	0,9065
Sulphur, mas.%	0,0195	1,18
Viscosity (100℃), mm^2/s	6,01	7,12
Refraction index (70℃)	1,4780	1,4874
Conradson Carbon, mas.%	0,11	0,40

Table 2: Physico-chemical properties of fresh and balance catalyst

FRESH CATALYST	
CORAL 753 + Resolve 7 0	
Chemical properties	
Al_2O_3, mas.%	44,1
Na, mas.%	0,29
RE_2O_3, mas.%	2,7
Physical properties	
Particle size distribution	
<149 µ	95%
<105µ	76%
<80µ	53%
<40µ	12%
<20µ	1%
Average particle size, µm	77
Specific area ,m^2/g	329
Pouring density, kg/m^3	721
Catalyst addition average, Kg/d	1200

BALANCE CAT.	
Chemical properties	
AL_2O_3, mas.%	44,2
RE_2O_3, mas.%	2,76
Na, mas.%	0,29
Fe, mas.%	0,32
Carbon, mas.%	0,04
Ni, ppm	1528
V, ppm	1353
Physical properties	
Particle size distribution	
<105µ	71%
<80µ	40%
<60µ	11%
<40µ	0%
Average particle size, µm	87
Specific area, m^2/g	124
Pouring density, kg/m^3	850
Activity, %wt	70

Feeds: Vacuum gas oil (unhydrotreated – UHT feed) and MHC residue (hydrotreated – HT feed). Physico-chemical properties are shown in Table 1.

Catalyst: Commercial, of zeolitic type (Coral 753 + Resolve 700). Physical and chemical properties are shown in Table 2.

Process Conditions: Temperature of feed pre-heating 233℃, temperature of the riser 535℃, C/O=7.0

3.2. MHC Process

For monitoring the operation of the MHC process yielding the feed for the FCC process (MHC residue) used were the average values of data for two operating periods of four days, under different process conditions.

Feed: Vacuum gas oils + heavy gas oil from the atmospheric distillation. Physico-chemical properties are shown in Table 3.

Tabe 3: Physico-chemical properties of the feed

Fee l		**1**	**2**
Density	kg/m^3	890,95	894,53
Sulphur	mas %	1,0125	1,1233

Process conditions: shown in Table 4.

Table 4: Parameters of MHC process for different degrees of operation severity.

MHC		**OPERATING MODE**	
		1	**2**
Input temperature in 26 R-1	℃	375	379
Input temperature in 26 R-2	℃	381	386
WABT*	℃	382	388
Pressure at the VT system	bar g	55	55
ppH_2	bar a	54	55
Make-up gas	kg/h	2875	2733
Chemical H_2 consumption	$Nm^3\ H_2/m^3$	47,3	40,3

*Weighted average bed temperature

4. Results and discussion

The paper has investigated the impact of feed hydrotreatment on the distribution of products of the process of catalytic cracking (FCC). Two feeds were applied, the first one being standard (vacuum gas oils), and the other being that same feed subjected to the process of mild hydrocracking (MHC) at different operating conditions (Tab.1).

The results in Figure 1. show the change in the content of sulphur in the feed, as well as in the MHC process residue, in dependance of the operating mode (period 1 and period 2).

The results in Figure 2 show the impact of the input feed temperature at the entrance to reactor R-1 on sulphur content in the MHC residue. One may observe a significant impact of the temperature as a process parameter, whose increase causes the sulphur content to decrease, which is especially visible at the highest input feed temperature (end of period 2).

Temperature reduction at the reactors conditions increased yield of the MHC residue since temperature reduction at the reactors lowers the share of hydrocracking reactions, thus reducing also the yields of lower boiling point products, such as gasoline and gas oil fractions (Figure 3).

It is well known that the process of hydrotreating catalytic cracking feed increases cracking capability, as seen from the distribution of products of the FCC process, obtained for both hydrotreated and unhydrotreated feed. The results in Figure 4 show the larger achieved conversions by applying hydrotreated feed, thus confirming a higher affinity to cracking of the paraffinic type feeds (K=12.1), as the one obtained by the process of MHC. Given that, higher yields of LNG fractions and gasoline were obtained, with lower yields of light cyclic oil (LCU) for hydrotreated feed, as shown in Figures 5, 6 and 7.

Table 5: The quality of FCC gasoline in dependence of feed properties

FCC GASOLINE	FEED	
	HYDROTREATED	UNHYDROTREATED
RON	91,63	93,1
MON	81,00	80,7
Sulphur, mas. %	0,0013	0,0775
Olefins, vol. %	20,67	36,66
Aromatics, vol. %	23,84	25,17
Paraffins+Naphthenes, vol. %	55,49	38,17
Bromic number	35,9	73,00
End distillation point, °C	201	204

Given the large share of hydrogenation reactions in the observed area of temperatures and other conditions of MHC process, one may observe changes in composition as well as in the octane number of FCC gasoline. By applying hydrotreated feed, we have observed a reduction in the olefins and aromatics content, as well as an increase of the paraffinic hydrocarbons type share. These changes in the composition of FCC gasoline have conditioned a reduction in the values of research octane number (RON), as seen from the results shown in Table

5. The said reduction of the gasoline octane number, caused by the hydrotreatment of FCC feed, may be compensated for by the choice of the catalytic cracking process conditions impacting an increased share of iso-paraffins in FCC gasoline.

5. Conclusion

The results of the performed investigation have shown that the hydrotreatment of the feed for catalytic cracking through MHC process impacts increased conversion and yield of gasoline and LNG fractions, with a reduced yield of light cyclic oil. By applying hydrotreated feed, LMG yield increase of 4-5 mas. % has been achieved, with an increased gasoline fraction yield of around 8 mas %.

At the same time, reduction of the gasoline octane number value (RON) has been established for the hydrotreated feed, constituting an unwanted impact of the catalytic cracking feed hydrotreatment process.

MHC process of the catalytic cracking feed has reduced sulphur content from 1.18 mas. % to 0.0195 mas. %. Application of hydrotreated feed in the FCC process has achieved a very low sulphur content of 0.0013 mas. % in gasoline, with regard to sulphur content of 0.0775 mas. % in the same fraction obtained through the cracking of unhydrotreated feed.

FCC gasoline obtained through the application of hydrotreated feed is used as component for blending in the production of low sulphur gasoline of European quality, while the application of high sulphur FCC gasoline is possible exclusively in the production of gasoline for the markets where gasoline with both higher and high sulphur content may be sold.

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UDK/UDC	Ključne riječi	Key words
665.644.26	frakcija benzina FCC, iz predhodno HDS/BHK obrađene sirovine	FCC gasoline from HDS/MHC pre-treated feedstock
665.644.2-948	blagi hidrokreking, BHK radi desulfurizacije	mild hydrocracking, MHC for desulphurization
.002.33	gledište izbora i predobrade sirovina	raw materials choice and pretreatment viewpoint

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