

trolled in the case of all three alkyl verdazyls. To study living character of the process, macroinitiator **3** was used for butyl acrylate polymerization. As a result, co-polymer **4** was obtained.

To sum up, the principal possibility of using alkylated verdazyl radicals as initiators for controlled living polymerization was shown. It was found that

nature of C3-substituents does not effect on polymerization results. Further, we plan to vary monomer applied as well as to perform photoinduced polymerization.

The reported study was funded by State Project “Science” №WSWW-2020-0011.

References

1. Gimes D. (Ed.). *Nitroxide mediated polymerization: from fundamentals to applications in materials science, 2016– 19.*– Royal Society of Chemistry.
2. Postnikov P., et.al., *Unprecedented plasmon-induced nitroxide-mediated polymerization (PINMP): a method for preparation of functional surfaces. Journal of Materials Chemistry A, 2019.*– 7(20).– 12414-12419.
3. Rayner G., et.al., *A comparison of verdazyl radicals modified at the 3-position as mediators in the living radical polymerisation of styrene and n-butyl acrylate, Polymer Chemistry, 2012.*– 3(8).– 2254–2260.
4. Petunin P.V. et.al. *Oxidative addition of verdazyl halogenides to Pd(PPh 3)4. New Journal of Chemistry, 2019.*– 43(38).– 15293–15301.
5. Matyjaszewski K., et.al., *Simple and efficient synthesis of various alkoxyamines for stable free radical polymerization, Macromolecules, 1998.*– 31(17).– 5955–5957.

THE STUDY OF FEEDSTOCK AND PRODUCTS OF CATALYTIC CRACKING AND HYDROCRACKING

E.K. Vymyatnin, A.A. Oreshina

Research advisor – professor E.D. Ivanchina

National Research Tomsk Polytechnic University

634050, Russia, Tomsk, 30 Lenin Avenue, EKVT70@gmail.com, sasha.oreshina.94@mail.ru

Today, there are many advanced oil refining processes, but the main ones and the most common are catalytic cracking (CC) and hydrocracking (HC), due to their technological flexibility and

versatility [1]. Hydrocracking is essentially a type of catalytic cracking carried out in a hydrogen environment. The main advantage of hydrocracking over catalytic cracking is the production of more

Table 1. Feedstock density and molecular weight

Hydrocracking				Catalytic cracking			
UH-1	MW	g/mol	256.2	SD-1	MW	g/mol	142.3
	Den	g/cm ³	808.5		Den	g/cm ³	946.0
UH-2	MW	g/mol	221.8	SD-2	MW	g/mol	149.2
	Den	g/cm ³	826.9		Den	g/cm ³	969.3
UH-3	MW	g/mol	233.1	UG-1	MW	g/mol	96.0
	Den	g/cm ³	790.4		Den	g/cm ³	758.2
SD 200-360	MW	g/mol	241.8	UG-2	MW	g/mol	98.6
	Den	g/cm ³	825.2		Den	g/cm ³	761.1
2nd line feed	MW	g/mol	315.7	feed 1	MW	g/mol	341.3
	Den	g/cm ³	906.7		Den	g/cm ³	892.7
2nd stage feed	MW	g/mol	367.6	feed 2	MW	g/mol	342.1
	Den	g/cm ³	836.2		Den	g/cm ³	889.9
1st line feed	MW	g/mol	357.7	feed 3	MW	g/mol	338.5
	Den	g/cm ³	914.5		Den	g/cm ³	890.6

here Den – density; UH – unstable hydrogenate; SD – summer diesel; UG – unstable gasoline

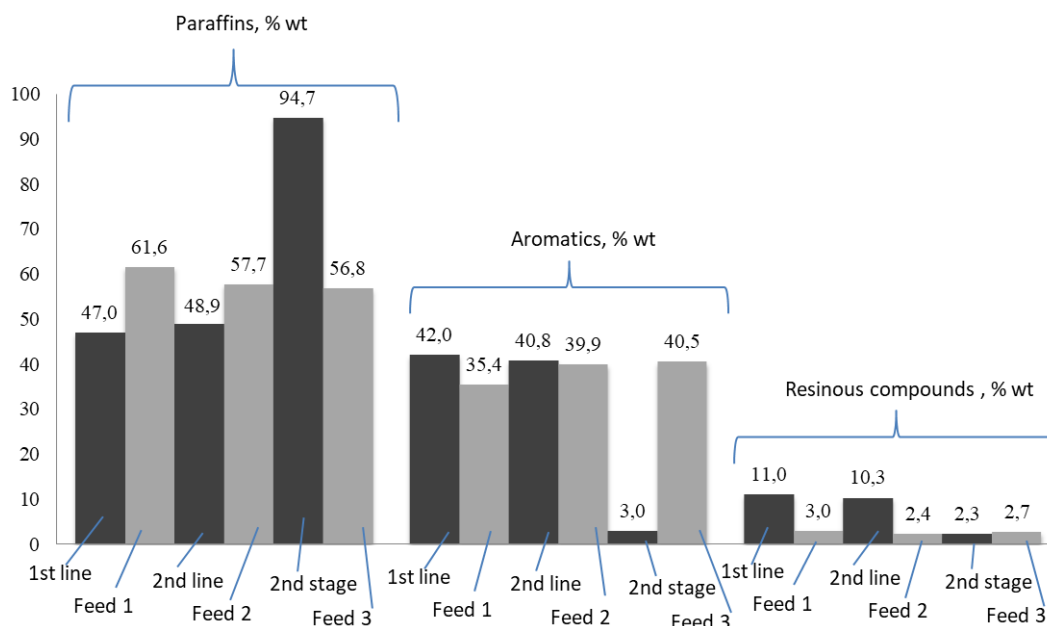


Fig. 1. Comparative chart of the CC and HC feedstock group composition analysis results

hydrogen-rich products due to the hydrogenation and saturation of aromatic rings [2]. In addition, hydrotreating takes place during the process, primarily removes sulfur and nitrogen. Also, in the hydrocracking process there is no loss of carbon caused by its deposition on the catalyst, which is typical for catalytic cracking [2].

The aim of this work is to compare the effectiveness of hydrocracking and catalytic cracking processes by studying the features of its feedstock and products.

Figure 1 shows the group composition determination results of CC (Feed 1, 2, 3) and HC (1st, 2nd line, 2nd stage) feedstock samples. Data was obtained by silica gel column chromatography. In addition the group composition of the products of these processes was determined. The group composition of two unstable gasoline samples was determined by gas chromatography. The average content

of aromatics – 43.26 % wt., olefines – 17.59 % wt. and paraffins – 39.15 % wt.

Table 2 presents the the molecular weight (MW) of the processes feedstock and products determined by cryoscopy, as well as their density measured by a Stabinger viscometer Anton Paar SVM3000.

The data on feedstock and products MW, density and group composition allows to estimate processes effectiveness.

In addition, the CC and HC feedstock and products sulfur content was determined using the energy-dispersive sulfur analyzer Spectroscan SL, which made it possible to estimate the effectiveness of the hydrotreating reactions of the HC process.

In the future, the data obtained in this study will be used to improve the HC and CC processes predictive models, which will become the basis of computer programs allowing to calculate the target products yield and monitor the catalyst activity.

References

1. Speight J.G. *Handbook of Industrial Hydrocarbon Processes*. Oxford: Gulf Professional Publishing, Elsevier, 2011.– 806 pages.
2. Haitham M.S. Lababidi, Dduha Chedadeh, Ri-azi M.R. et al. Prediction of product quality for catalytic hydrocracking of vacuum gas oil. // *Fuel*, 2011.– V.90.– №2.– P.719–727.