International Journal of
Inclusive and Sustainable Education
ISSN: 2833-5414
Volume 1 | No 5 | Nov-2022

Structure and Properties of Oil Compositions

Komilov M. Z.[1]**, Sharipov B. Z.**[2]**, Gaibullaeva A. F.**[3]

[1, 2] Associate Professor, Bukhara Engineering and Technology Institute
[3]Senior Lecturer, Bukhara Institute of Engineering and Technology

Annotation: The article analyzes the structure and properties of oil compositions. Theoretical ideas about oil dispersed systems, options for controlling phase transitions, balances of intermolecular interaction forces, and methods for achieving the active state of raw materials through various types of influences on it are presented, which makes it possible to find practical ways to optimize technological processes. These principles are stated in relation to the processes of primary oil refining, namely, demulsification and direct distillation of oil.

Keywords: Structure, composition, oil refining, scientific and technological progress, oil products.

The non-renewability and limited resources of natural hydrocarbon raw materials (in particular, oils and gas condensates), on the one hand, as well as the need for a more economical use of waste oil products, on the other hand, require systematic research to find rational ways to process them.

The deepening of oil refining by intensifying its atmospheric-vacuum distillation can be achieved by improving technological processes, increasing the unit capacity of industrial plants in terms of feedstock. However, the possibilities of deepening oil refining by automating individual operations and improving the hardware design of processes are generally limited. The development of scientific and technological progress in the field of the oil refining industry has made it necessary to move to fundamentally new technological processes that ensure the highest efficiency in the processing and use of oil and oil products and are based on comprehensive physical and chemical studies of the composition, structure and properties of oil systems. This approach makes it possible to optimize, without significant material costs, those technological processes of oil production, transportation and refining, as well as the properties of oil products that could not be intensified by other methods.

At present, polymer composite materials are one of the most demanded materials in many branches of human activity, and every year the scope of their application is expanding, and production volumes are increasing. Polymer composite materials are most widely used in the construction industry, in the production of hulls in the ship, aircraft, and automotive industries, as well as in the production of structural, friction, and antifriction parts [1–4]. This is due to the fact that, on the one hand, these materials combine lightness, high mechanical properties, chemical resistance and water resistance, and on the other hand, there is a wide variety of types of polymer composite materials that differ in their properties, which allows you to select the optimal composite material. for specific operating conditions [5-8].

Another important advantage of polymer composite materials is the ability to develop new and improve existing composite materials, which further expands the possibilities of their application and increases their competitiveness with other materials, enhances their advantages and reduces disadvantages, which include relatively low heat resistance, flammability and the phenomenon of aging. Polymer binders under the influence of ultraviolet light and other environmental factors.

Associated petroleum gas , which is produced along with oil, is collected and sent to a gas processing plant (GPP). There, associated petroleum gas is also divided into groups of components. There are only two of them. One group contains the lightest gases (methane and *ethane)*, which are sent to consumers and, for example, are burned in the burners of household stoves or in thermal power plants. The second group is a mixture of other gases. It is called a wide fraction of light hydrocarbons , along with straight-run gasoline , it is used by petrochemists as a raw material [9-10].

Natural gas differs from associated petroleum gas in that it lies in the subsoil on its own, while associated gas is dissolved in oil. In addition, the compositions of these gases differ. However, not qualitatively, but only quantitatively. Therefore, the processing of natural gas is in many ways similar to the processing of associated petroleum gas . The lightest gases - *methane* and *ethane* - are separated and sent to main pipelines for delivery to consumers. Sometimes, during the processing of natural gas, *ethane* is nevertheless isolated individually - when its content is high - since *ethane* is a valuable petrochemical raw material. The remaining components of natural gas are also called the wide fraction of light hydrocarbons; they are collected and supplied to the petrochemical industry.

Thus, the processing of fossil hydrocarbons gives the petrochemical industry three types of raw materials: straight-run gasoline from refineries, a wide fraction of light hydrocarbons from gas processing plants, and *ethane.*

Since the broad fraction of light hydrocarbons is a mixture of gases, it can be further separated. This is how liquefied hydrocarbon gases are obtained - these are pure gases or special technical mixtures (for example, "propane-butane"), which are used for heating, for example, country houses and summer cottages, or as automobile fuel - this is the so-called autogas . But liquefied hydrocarbon gases are also used as feedstock for petrochemicals.

The next step in processing is the key. Raw materials (straight-run gasoline, ethane, wide fraction of light hydrocarbons, liquefied hydrocarbon gases) in various ratios are subjected to a complex high-temperature process - pyrolysis (from other Greek π ῦρ - fire, heat and λύσις - decomposition, decay). It is important to realize that in this process, the starting substances are converted into other types and classes of chemical compounds, which means that the properties of the starting substances are fundamentally different from the properties of the products. The transformation of raw materials into new types of substances with new unique properties makes pyrolysis the most important step in petrochemistry.

The most important group of pyrolysis products are the so-called olefins. This term usually refers to *ethylene* and *propylene.* How do these substances differ from the original ones, why should they be obtained? First, olefins are almost impossible to find on earth in their natural free form. Their artificial production from fossil hydrocarbons is the first and most important task of the petrochemical industry. Secondly, these substances are capable, under certain conditions, of combining with themselves into very long molecular chains - polymers. This ability is absent in almost all the original compounds contained, for example, in naphtha or a wide fraction of light hydrocarbons [11-13].

Meanwhile, polymers are the most important petrochemical products. After certain transformations, unique for each type of polymer, the following are formed: *polyethylene* (bags and films are made from it), *polypropylene* (automotive parts, films, equipment), *polyvinyl chloride* (window profiles, linoleum, suspended ceilings), *synthetic rubbers* (rubber, car tires , shoe soles) and many other polymers.

But during pyrolysis, not only olefins are formed, but also other classes of products. They are also used in the petrochemical industry and are converted, for example, into solvents, fuel additives, paint components, antifreezes, lubricant components, perfume bases and many other important products.

After oil, the second most important source of raw materials for the petrochemical industry is the processing of associated petroleum gas.

Associated petroleum gas is light, gaseous hydrocarbons under normal conditions (methane, *ethane*, *propane*, *butane*, *isobutane* and some others), which are under pressure under geological (reservoir) conditions and are dissolved in oil. When oil is brought to the surface, the pressure drops to atmospheric pressure and the gases boil away from the oil. Additional associated gas can also be obtained by heating crude oil. Simplifying, we can say that this process is similar to what happens when you open a bottle of champagne or sparkling water: when the container is opened and the pressure drops, $CO_{2\ bubbles}$ begin to emerge from the solution.

The composition of associated gas, as well as its content in oil, varies over a fairly wide range and differs depending on the specific characteristics of the field. However, the main component of the associated gas is *methane* - the simplest organic compound, familiar to all of us with its blue flame in the burners of household stoves.

Until recently, the beneficial use of associated petroleum gas was not among the priorities of oil and gas companies. Associated petroleum gas was separated from the oil during its preparation for transport and simply burned in flare installations right at the field. For many years, the flame of these torches lit up the night sky over the producing regions and was one of the symbols of the oil industry. Recently, the situation has changed, mining companies are introducing a variety of ways to use associated petroleum gas as fuel for small power plants, and petrochemists use it as a feedstock [14-16].

The fact is that associated gas components with more than 2 carbon atoms (the so-called C 2 + fractions) can be involved in further processing to obtain valuable petrochemical products. However, the need for utilization and beneficial use of associated gas is determined not only by economic considerations. Burning torches deal a severe blow to the ecology of our planet. Their yellow flame indicates that the torches are “smoky”, that is, soot and soot are formed during combustion. The same thing happens with torch soot, which migrates following the winds and harms the environment and human health thousands of kilometers away from oil producing regions. In addition, when associated gas is flared, so-called "greenhouse gases" (carbon dioxide and carbon monoxide) are released, which cause a "greenhouse" effect and cause changes in the global climate. So the processing of associated petroleum gas, its beneficial use is a necessary work to protect the health of the population and the ecology of the planet for future generations.

The essence of qualified gas processing is the separation of C 2 + fractions from methane, acidic (hydrogen sulfide) and inert (nitrogen) gases, as well as water and mechanical impurities.

The processes of separating valuable fractions from associated gas are based on two principles. The first is implemented in low-temperature condensation plants, where gases are separated according to liquefaction temperatures. For example, methane at atmospheric pressure passes into a liquid state at -161.6 ° C, ethane - at -88.6 ° C. Propane liquefies at -42°C, butane at -0.5°C. That is, if the gas mixture is cooled, a liquid containing *propane*, *butane* and heavier components will begin to condense from it, and *methane and ethane will remain in the gaseous state.* The liquid product of low- temperature condensation plants is called a wide fraction of light hydrocarbons , since it is a mixture of substances with two or more carbon atoms (C 2 + fraction), and the gaseous part (methane and part of ethane) is called dry stripped gas (COG) - it is sent to the gas transmission system of OAO Gazprom.

The second principle is implemented in low-temperature absorption plants and consists in the difference in solubilities of gases in liquids. Low-temperature absorption columns can be filled, for example, with circulating liquid propane, and the source gas passes through it with bubbles - bubbled or, in simple terms, “bubbling ". In this case, the target components are dissolved in liquid propane, and methane and ethane - dry gas components - pass without absorption. Thus, after a series of cycles, liquid propane is enriched with "fatty" components, after which it is used as a commercial product as a wide fraction of light hydrocarbons. In some cases, hydrocarbons are used as a liquid absorbent. Then, for separating equipment, the not entirely successful, but historically well-established term oil absorption plant is used.

Polyethylene is the most common and widely used polymer. Most of polyethylene is known for its role in everyday life: plastic bags and plastic wrap are what each of us deals with every day. Polyethylene is light and flexible, does not allow water or air to pass through, providing protection for what is contained in it. This is what makes it very useful for storing, for example, products. From the point of view of chemistry, polyethylene - a polymer of composition - $(CH_2)_n$ -, refers to thermoplastics, that is, when heated, it becomes plastic and can be processed by molding, casting or extrusion - forcing the melt through holes of various configurations to obtain threads, thin layers, etc. From everyday experience, many people know that polyethylene softens when heated. But the appearance of the polyethylene that is produced at petrochemical plants is far from the type of products made from it. Factory polyethylene is white granules. It was in the form of a white precipitate that it was first obtained [17].

Polypropylene (PP or PP) is the second polymer product in terms of production tonnage after polyethylene. Compared to polyethylene, it has a lower density, which means it is lighter. In general, polypropylene is the lightest of the mass-produced thermoplastics. In addition, polypropylene is also more thermally stable: the performance of products is maintained up to 140-150 ° C. On the other hand, polypropylene is less resistant to frost than polyethylene: at low temperatures it becomes brittle, so use products and parts made of polypropylene under load in regions with harsh climate is impossible. But in general, many different products are made from polypropylene, from the film in which cigarette packs are wrapped to the dashboards of cars.

Due to the presence of an additional carbon atom sticking out of the chain, polypropylene is more sensitive to light and oxygen. To reduce this effect, special substances are introduced into polypropylene, called stabilizers - they inhibit destructive processes in the polymer.

Polystyrene is a thermoplastic polymer of styrene, designated PS or PS. Unlike its counterparts polyethylene and polypropylene, polystyrene monomer is not so simple in structure and in manufacturing.

Polyvinyl chloride (PVC, PVC) is perhaps the most famous polymer in the masses. For most of us, this abbreviation is strongly associated with window profiles used in the manufacture of double-glazed windows, which are firmly established in the everyday life of residents of modern cities [18].

Synthetic rubbers are an extensive group of petrochemical products, including dozens of different substances. These are also **polymers,** however, they differ from all those described above in that they are not **thermoplastics,** but belong to the class of **elastomers,** and that is, they have highly elastic properties. In other words, when a force is applied, elastomers can stretch several times and then return to their original state when the load is removed. Of the natural substances, such properties are possessed by natural rubber obtained from the juice of the tropical plant hevea, and rubber based on it. However, the development of human civilization required finding a more accessible and cheaper replacement for it. Petro chemistry again came to the rescue, creating synthetic substances, even surpassing natural rubber in their properties. And today, about 60% of the rubber market is synthetic, and another 40% is natural.

The class of products of organic synthesis also includes acetone and phenol. The first is known to many as a universal solvent, but phenol is not widely known, since it is not used in everyday life (the exception is “carbolic”, a solution of phenol in water used in medicine). Based on phenol, phenol-formaldehyde resins are produced - plastics used, for example, in the manufacture of chipboard (chipboard) and billiard balls. Acetone and phenol are obtained simultaneously by the so-called " cumene method". At the beginning of this chain are already known to us benzene and propylene.

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