The history of the development of procedures for the production of Russian highway asphalts (the percentage of these asphalts approaches 70-75% of the total production of all asphalts) has gone through several stages from periodic oxidation in stills and compressor-free reactors to modern automated combined productions including different types of continuous-action tower oxidation units, and heavy-duty compounding units for the feedstock and final production.

Naturally, the increasing requirements of consumers (highway engineers) with regard to the quality of highway-grade asphalts has served as a stimulus for the development of the procedures.

As a rule the first generation of highway asphalts produced since the middle of the last century – VN-grade asphalts – possessed neither high plasticity, nor the low-temperature properties suitable for Russia’s climatic conditions; this was dictated by the low level of user requirements as to quality and volumes of highway construction. Naturally, the production of this product at petroleum refineries had not introduced serious requirements for the quality of the crudes being refined, nor for the quality of the feedstock obtained from them for the production of asphalts-hydrones. At a number of refineries, moreover, difficult-to-utilize intermediate products and wastes of other petroleum-refining processes had been “dumped” into this feedstock: cracked tars, atmospheric resids, secondary gasoils, asphaltites, various still resids, etc. [1-4].

The second generation of highway asphalts are those Grade BND asphalts produced in accordance with GOST 22245–90, which satisfy high standard requirements set forth for plasticity, and also low-temperature properties, as well as resistance to heat-induced oxidative aging, etc. With the production of these asphalts, however, certain problems with the stability of their quality, above all, plasticity, low-temperature properties, and resistance to aging, had begun to emerge at refineries. In the first phase, this was associated with commencement of the broad involvement of high-paraffin crudes at the refinery during this period. Another cause was the absence of monitoring and regulation of the distillation and batching curves of the oxidation feedstock – hydrones.

To solve these problems, oil refiners focused increasing attention on the quality of the feedstock for asphalt production. Some refineries had attempted to go over to the European method: use of heavy, highly resinous Yaregsk, Arlansk, Romashkinsk, and other types of crudes for the production of highway asphalts (for example, Grades BDU, BNN, etc.). Owing to a number of objectionable situations, however, this method was found little-effective, and in some cases, a blind alley. The basic part of Russia’s producers, however, have preferred the
development of effective process solutions for stabilization of the distillation and batching curves of the feedstock being refined [5-7].

A novel procedural solution – preparation of the feedstock for oxidation – was first implemented in asphalt production at a number of Russian refineries. As we know, even small fluctuations in the composition of the feedstock – its content of \( n \)- and \( isoparaffin \), aromatic, and other hydrocarbons, and tars and asphaltines – exert a major influence on the quality of the highway asphalts produced. Its “contribution” to instability of the quality of the feedstock – also introduces procedural peculiarities to vacuum-tower operation: fluctuations of the temperature regime, depth of vacuum, consumptions of feedstock, refluxes, and vapor, and also the effectiveness of mass- and heat-exchange contact devices, etc. The development of a special unit for the preparation of feedstock delivered for oxidation therefore solves two interrelated problems in modern asphalt production: optimization of both the distillation, and also batching curves of the feedstock [8-10].

Optimization of the degree of “weighting,” i.e., distillation curve, of the hydrone also simultaneously leads to a reduction in the degree of its “paraffin impregnation,” i.e., optimization of its chemical batching curve. And, the distillation curve of the prepared hydrone can be simultaneously regulated by increasing the degree of “aromatization” of the feedstock (for example, by the method of compounding). Actually, moreover, it is very important to optimize, and not simply vary the composition of the feedstock, as is done today at a number of refineries that continue to utilize certain intermediate products.

The appearance of a third generation of highway asphalts is associated with tightening of user requirements (above-all, the Federal Highway Administration, Ministry of Transportation of Russia), as to the quality of highway asphalts with respect to strength and low-temperature properties. Fulfillment of these requirements, which are more stringent than those set forth in GOST 22245–90, is possible either by the refinement of qualitatively unique crude, or, as Z. I. Syunyaev and A. A. Gureev have demonstrated in their developments, by compounding commercial production. The latter trend, which is associated with regulation of the dispersity of the asphalts, has made it possible for a number of refineries to organize the output of a so-called “brandy” product [7, 9, 10].

A joint development of the I. M. Gubkin Russian State University of Oil and Gas and the publicly owned joint-stock company Rosneft’–Novokuibyshevskii NPZ for the production of highway asphalts with an extended service life – Grades BDD and BDD-A – has become a distinct example of this innovative approach to modernization of one of the most complex oil-refining processes. This procedure is based on regulation of the ratio and nature of the phases and media by optimizing the batching and distillation curves of the hydrones and asphalts. Such optimization will raise the level of the low-temperature and plastic properties of highway asphalts, while retaining their required strength properties [9].

The procedure in question for the production of Grade BDD 60/90 and BDD 90/130 asphalts with an extended service life includes preparation of the feedstock based on high-end-point hydrones and combined compositions of stabilizers – compounds of intermediate products of petroleum-refining processes, oxidation, and compounding of the prepared oxidized hydrone with unoxidized hydrone.

Further developments have led to the creation of a procedure for more profitable production of Grade BDD-A asphalts based on oxidized asphaltite. The three-stage oxidation procedure of asphaltite with modifying additives and subsequent compounding of the oxidized product with hydrone will permit qualified utilization of up to 30-35% of the mass of asphaltite, and remove up to 70% of the mass of the hydrocarbon feedstock from the extremely ecologically “dirty” oxidation process. In terms of level of basic in-service properties, the Grade BDD-A 60/90 and BDD-A 90/130 highway asphalts obtained here are superior to the corresponding standard Grade BND asphalts [11].

The quality of the Grade BDD and BDD-A highway asphalts is regulated by STO No. 05766600-001–2008