Artículo de investigación

Raw materials for the production of trotyl in the context of the development problems of the soviet oil industry in the 1920-1940s

Сырьевое Обеспечение Производства Тротила в Контексте Проблем Развития Советской Нефтяной Промышленности в 1920 – 1940-е гг

Materias primas para la producción de trotilo en el contexto de los problemas de desarrollo de la industria petrolera soviética en los años 1920-1940

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Abstract

The Second World War influenced on the history of the twentieth century a lot. Based on its results, many conclusions were made and a huge number of works were written. However, even 75 years after the end of this bloody war, for all time of the existence of humanity, there are still a lot of questions that need to be revealed and they are ¨waiting¨ for their researchers.

The Second World War is a confrontation between economically developed countries, which had powerful manufacturing (industrial) and mining (raw materials) sectors. However, in some countries, some important defense industries were not always provided with a raw material base appropriate to their needs.

One of such branches of the military industry in the Union of Soviet Socialist Republics (USSR) in the 1920-1940s was the industry for the manufacture of explosives, producing for the Red Army trotyl (TNT) as the main type of explosive. The combat readiness of the Soviet army in large-scale military conflicts directly depended on different types of TNT equipment and the purpose of the ammunition.

The main raw material base for the production of TNT in the USSR was oil products, which required a significant increase in oil production in the country. For various reasons, this did not happen, on the contrary, oil production during the war was significantly reduced. This circumstance made it impossible to supply parts of the Red Army with TNT ammunition from the Soviet Union's own resources. This meant a sharp decrease in the effectiveness of the actions of Soviet army during the battles with Nazi

Аннотация

Вторая мировая война оставила неизгладимый след в истории XX века. По ее итогам было сделано много выводов и написано огромное количество работ. Однако даже через 75 лет после окончания этой самой кровавой войны за все время существования человечества еще осталось масса вопросов, требующих своего раскрытия и ждущих своих исследователей.

Вторая мировая война представляет собой противоборство экономически развитых стран, имевших мощные производящий (промышленный) и добывающий (сырьевой) сектора. Тем не менее, в отдельных странах некоторые важные оборонные отрасли промышленности не всегда были обеспечены соответствующей их потребностям сырьевой базой.

Одной из таких отраслей военной промышленности в СССР в 1920 – 1940-е гг. стала промышленность по изготовлению взрывчатых веществ (ВВ), выпускавшая для Красной Армии в качестве основного типа ВВ тротил. От снаряжения тротилом разного вида и предназначения боеприпасов напрямую зависела боеспособность советских войск в крупномасштабных военных конфликтах.

Главной сырьевой базой для производства тротила в Советском Союзе стали нефтепродукты, что, в свою очередь, потребовало существенного увеличения добычи нефти в стране. В силу разных причин, этого не произошло; наоборот, добыча нефти в ходе войны существенно

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aggressors. Only appropriate supplies to the USSR from the United States made it possible to fill the shortage of ammunition in the Red Army and carry out a number of successful operations (especially in 1944-1945), which led to the collapse of the Third Reich.
In this article, for the first time, we can find the data on volumes of production and import of explosives in the USSR during the Second World War. The features of the development of the Soviet oil industry in the 1920-1940s are analyzed. There are the reasons for the sharp decline in oil production and the effect of this factor on the supply of Soviet troops with ammunition in the first half of the 1940s.

Keywords: Explosives, lend-lease, oil fields, pyrolysis of petroleum products, toluene.

сократилась. Данное обстоятельство сделало невозможным обеспечение частей Красной Армии боеприпасами, снаряженными тротилом, за счет собственных ресурсов Советского Союза. Это означало резкое понижение эффективности действий советских войск в ходе боев с немецко-фашистскими агрессорами. Только соответствующие поставки в СССР из США позволили восполнить нехватку боеприпасов в Красной Армии и провести ей ряд успешных операций (особенно в 1944 – 1945 гг.), приведших к крушению Третьего Рейха.
В предлагаемой статье впервые вводятся в научный оборот из недавно рассекреченных архивных источников данные об объемах производства и импорта ВВ в СССР в годы Второй мировой войны; детально анализируются особенности развития советской нефтяной промышленности в 1920 – 1940-е гг.; указываются причины резкого сокращения добычи нефти в первой половине 40-х гг. и влияние этого фактора на снабжение советских войск боеприпасами.

Ключевые слова: взрывчатые вещества, ленд-лиз, нефтяные месторождения, пиролиз нефтепродуктов, толуол.

Resumen

La Segunda Guerra Mundial influyó mucho en la historia del siglo XX. A partir de sus resultados, se sacaron muchas conclusiones y se redactó un gran número de trabajos. Sin embargo, incluso 75 años después del final de esa sangrienta contienda, todavía hay muchas cuestiones que necesitan ser clarificadas y están ¨esperando¨ a sus investigadores.
La Segunda Guerra Mundial fue una confrontación entre países económicamente desarrollados que poseían poderosos sectores manufactureros (industria) y mineros (materias primas). Sin embargo, en diversos países algunas importantes industrias de defensa no siempre recibieron una base de materia prima adecuada a sus necesidades.
Una de las ramas de la industria militar de la Unión de Repúblicas Socialistas Soviéticas (URSS) en los años 1920-1940 fue la industria para la fabricación de explosivos, produciendo trinitrotolueno para el Ejército Rojo (TNT) como el principal tipo de explosivo. La preparación de combate del ejército soviético en conflictos militares a gran escala dependía directamente de los diferentes tipos de equipos de TNT y de la finalidad de las municiones.
La principal materia prima para la producción de TNT en la URSS eran los productos petrolíferos, que requerían un aumento significativo de la producción de petróleo en el país. Por varias razones, esto no sucedió y, por el contrario, la producción de petróleo durante la guerra se redujo significativamente. Esta circunstancia imposibilitó el suministro de munición de TNT a partes del Ejército Rojo con recursos propios de la Unión Soviética. Esto provocó una fuerte disminución en la efectividad de las acciones del ejército soviético durante las batallas con los invasores nazis. Sólo los suministros apropiados entregados por los Estados Unidos a la URSS permitieron suplir la escasez de munición en el Ejército Rojo y llevar a cabo una serie de operaciones exitosas (especialmente en 1944-1945) que condujeron al colapso del Tercer Reich.
En este artículo, por primera vez, podemos encontrar los datos sobre los volúmenes de producción e importación de explosivos en la URSS durante la Segunda Guerra Mundial. En el documento también se analizan las características del desarrollo de la industria petrolera soviética en la década de 1920-1940. Asimismo, se exponen las razones que explican la fuerte disminución de la producción de petróleo y el

efecto de ese factor en el suministro de municiones a las tropas soviéticas en la primera mitad de la década de 1940.

Palabras clave: Explosivos, pirólisis de productos petrolíferos, trinitrotolueno, yacimientos petrolíferos.

Introduction

The Second World War is the last global challenge and threat to democracy and security on the planet. This topic is always actual, and with each new anniversary date, interest in it only grows. So, in 2019, we celebrated the 75th anniversary of the allied Anglo-American troops in Normandy (Operation Overlord, June 1944), in 2020, we will celebrate the 75th anniversary of the defeat and surrender of fascist German army.

In the modern world, in a difficult international environment, the Second World War is constantly politicized, primarily as the contribution and degree of participation of certain countries in the defeat of the Third Reich. This is really actual question right now, in conditions of aggravated relations between the Russian Federation on the one hand, and Western Europe and the United States of America (USA) on the other.

During the war about 70% of Wehrmacht divisions participated in battles on the Eastern Front against the Red Army, that is, the Soviet Union carried the brunt of the hostilities. At the same time, the ability of the Soviet army to effectively fight the enemy was determined by the economic assistance of the allies in the anti-Hitler coalition, especially from the USA, in the form of deliveries to the USSR of certain nomenclatures of military goods. One of the most important nomenclatures for the Soviet Union received from its Western allies was explosives and raw materials for their production.

This topic, due to its specificity, has never become the subject of a special study. Meanwhile, the importance of explosives for the successful conduct of hostilities in the conditions of the Second World War is difficult to overestimate. In fact, only the ammunition (artillery shell, mine, aerial bomb, grenade) equipped with explosives due to the detonation of the latter forms a damaging effect on the manpower of the enemy, his equipment and fortifications. Therefore, the absence of explosives leads to the absence of ammunition, which makes it impossible to effectively use their own tanks, artillery, aircraft. All of this becomes useless.

During the Second World War, Soviet army used several main types of explosives: trotyl, tetryl, hexogen, ten. The main one was trotyl or trinitrotoluene (TNT), whose specific weight in the total consumption of explosives by the Red Army for five years was about 96% (table 1) (Borisov & Postremova, 1947) Thus, the ability of the army to successfully fight the enemy directly depended on the state of affairs in the field of trotyl production for the subsequent equipment of ammunition.

Table 1. The total production of the main types of explosives in the USSR (in tons) in 1940-1944

Explosive	1940	1941	1942	1943	1944	Total (5 years)
Trotyl	81 552,0	111 380,0	80 247,0	97 912,9	95 032,4	466 124,3
Tetryl	1 238,8	2 309,6	2 403,0	2 798,3	3 724,8	12 474,5
Hexogen	128,0	204,8	1 834,0	2 669,0	2 411,8	7 247,6
Ten	-	30,5	78,0	137,4	176,9	422,8
Total	82 918,8	113 924,9	84 562	103 517,6	101 345,9	486 269,2

For the production of TNT in industrial volumes, we need an appropriate raw material base, it is the aromatic hydrocarbon toluene (the result of its processing of concentrated nitric acid is TNT). Accordingly, the availability of conditions for obtaining toluene in large volumes determined the ability of the URSS to effectively conduct large-scale hostilities, both defensive and offensive.

This question has not yet been shown by scientists in their works. The following objectives require a detailed study: the study of the state of affairs in the field of toluene

production in the USSR on the eve and during the Second World War and the identification of the factors that influenced this process, ways and methods of solving the problem of lack of toluene and TNT in the conditions of hostilities.

Theoretical basis

The main way to obtain toluene in the USSR was the pyrolysis (aromatization) of petroleum products. Kerosene served as a raw material for pyrolysis. In special apparatuses named retorts it was heated without air access to a temperature of 670 - 7000 C and decomposed into a number of products that were in a gaseous state. Aromatic hydrocarbons, including toluene, were among these products. The gas passed through a system of gas refrigerators and was washed with solar oil in order to extract aromatic hydrocarbons from the gas. On the whole, 25-35 kg of pyrogenetic (petroleum) toluene was obtained from one ton of kerosene (Leytman, 1947).

Since the raw material for the production of kerosene is oil, the production of toluene by pyrolysis required the creation of a powerful oil industry in the country, but there was a problem of finding new oil fields. There was no answer on this question in 1920-1930s, Soviet geologists and oil workers did not have a clear opinion, at what depth should oil be searched? Most experts adhered to the theory of primary formation of oil fields, according to which the places of accumulation of oil were at the same time the places of its formation. Applying this theory on the basis of practical results already obtained, leading Soviet geologists believed that oil should be extracted from a depth of 600-1300 m, from deposits of the Perm and coal (carbon) systems. They were opposed by supporters of the theory of the secondary formation of oil fields, who believed that oil had high mobility and was able to migrate in the earth's crust, both in section (vertically) and in area (horizontally). Therefore, supporters of this theory argued that the Permian beds and carboniferous deposits do not contain the main oil, it serves only as a sign of the presence of oil reserves in other, deeper layers, in particular Devonian, located at a depth of 1400 - 2000 m. However, the numerous attempts at exploration drilling undertaken before the war for the Devonian for several reasons did not lead to success. Meanwhile, as already shown by post-war studies, the theory of the secondary formation of oil fields proved to be correct. So, for example, in one of the richest oil regions of the USSR, the Volga-Ural basin, the depth distribution of oil reserves was characterized as follows: in the interval up to 1000 there was 9 % of the oil, from 1000 to 1500 m there was 29 % of the oil, from 1500 to 2000 m there was 55 % of the oil, from 2000 to 3000 m there was 7 % of the oil (Aliev & Shashi, 1968).

Methodology

The theoretical and methodological basis of the work is the general principle of historicism and objectivity. In accordance with the objectives of the research the author also used private historical methods: logical, systemic, chronological, actualization and periodization.

The article is written mainly on the basis of declassified materials intended for official use, archival documents from the Russian State Archive of Socio-Political History (RSASPH), as well as published but little-known studies and dissertations about the development of the USSR oil industry in the 1920-1950s. In addition, when writing the work, there are materials from some collections of documents devoted to the history of the USSR.

Discussion and results

During the war, the annual need for toluene in the USSR was about 80 000 tons, 70 000 tons of which of toluene were to be supplied through pyrolysis of kerosene (RSASPH, 664, 1, 72). About 14 million tons of oil was required to provide kerosene for the production of 70 000 tons of toluene. Meanwhile, during the war years, the annual demand for kerosene of other main consumers (Red Army and agriculture) averaged about 15 million tons of oil (RSASPH, 664, 1, 154). Thus, to fully supply the army, the defense industry and the national economy with only one kerosene (excluding other major petroleum products), approximately 29 million tons of oil was required annually. The Soviet oil industry was not prepared for it. There was a large miscalculation made in the field of development planning for the oil industry in the prewar period.

Before the Great Patriotic War, up to 70 % of oil was produced in the USSR in Baku oil fields. However, in the second half of the 1930s among Soviet geologists and oil industry workers there was the opinion that the main oil reserves are located not in the south but in the east of the country between the Volga and the Urals in the area of the “second Baku”. By 1940, such large oil trusts as «Ishimbayneft» and «Tuimazaneft» (Bashkir Autonomous Soviet Socialist Republic), «Syzranneft» (Kuibyshev Region), «Buguruslanneft» (Orenburg Region),

«Prikamneft» (Perm Region), etc. were already founded and there was functioned there.
The "second Baku" in terms of oil reserves there really exceeded the Baku oil fields. However, experts were not able to decide at what depths this oil should be found.

In the second half of the 19th century, the Mining Department of the Russian Empire became interested in oil production in the area. So, in 1863, on behalf of the Scientific committee of the Corps of mining engineers of the Mining Department, Professor G. D. Romanovsky made a geological study of the Volga region in order to determine their oil content. In his report he noted: "Permian oil sources should not be taken as indigenous sources of oil, but only as receivers of mountain oil emanating from the cracks." Romanovsky believed that "the outcome of oil should begin in the Devonian sediments" (Salimov, 2005).

In 1880s, geological surveys by Academician A.P. Pavlov were carried out in the Volga river. In 1887, his fundamental work "Samara Bend and Zhiguli" was published. It fully confirmed Romanovsky's idea of the secondary nature of Perm oil traits and their genetic relationship with deeper oil horizons. Pavlov believed that oil penetrated Permian sediments "from the outside, finding a way to the surface from the depths along rock cracks" (Salimov, 2005).

However, in the 1920s, there was another point of view in the USSR, the most consistent defender of which was the geologist K. P. Kalitsky. He proved the primary character of Permian oil features, arguing that oil in Perm rocks was formed from flowering plants, and did not migrate there from deeper Devonian sediments. Thus, according to Kalitsky, the presence of a small amount of oil in Perm sandstones was not evidence of the presence of even more significant reserves at a greater depth (Devonian). On the contrary, Kalitsky insisted on the futility of oil fields in the Volga-Ural basin in terms of industrial production of oil. The leadership of the Geological Committee under the USSR Academy of Sciences fully supported Kalitsky. So, for example, in 1926-1927 no one geological reconnaissance party was sent to this area.

Supporters of the theory of the secondary formation of oil fields were grouped around the rector of the Gubkin Russian State University of Oil and Gas. However, the Scientific and Technical Directorate of the Supreme Council of the National Economy (STD SCNE), which was responsible for financing geological surveys for a long time supported the Geological Committee. This forced Gubkin to seek support even among the party elite of the capital, in particular the first secretary of the Moscow city committee of the AUCPB (All-Union Bolshevik Communist Party) N. A. Uglanova. So, at one of the plenary sessions (meetings) of the Central Committee of the party (CC AUCPB) Uglanov described the situation: «A number of comrade communists, prominent scientists, including comrade Gubkin … actually from the collegium of scientific and technical management SCNE kicked out … The State Oil Research Institute is virtually wiped out and has no influence on the developing capital construction in our oil industry … The Petroleum Research Institute is given some kind of miserable 300 000, and all millions are given to the Geological Committee. And who is sitting on this Geological Committee? All bisons. And research institutions, where new scientific personnel, new forces begin to take shape, these institutions are shaking, do not give an extra penny. It can be proved. The Moscow Committee has these materials at the disposal» (Transcript of the joint plenum of the Central Committee and Central Control Commission of the AUCPB April, 1928, 2000).

The first oil field of the «second Baku» was discovered only in April 1929 in the Verkhne-Chusovsky towns of the Perm Region at a depth of 330 m. It happened by accident. So, when contouring a potash deposit from a well from a depth of about 300 meters, drilling fluid with oil and gas bubbles began to flow, and then an oil fountain with a flow rate of up to 20 tons per day hit (Baibakov, 1984).

In October 1930, 51 drilling rigs were operating in the area. However, according to the theory of the primary formation of oil fields, all of them were drilled to a shallow depth and therefore the expected discoveries of large oil fields did not follow. Therefore, already in 1931, some geologists began to actively advocate curtailing exploration work in this region and directing all efforts and resources to the southern regions.

The situation was saved by a well № 702, drilled near the village of Ishimbay on the right bank of the Belaya River to a depth of 680 m (Permian deposits): on May 16, 1932, it produced a powerful oil fountain. Following it, other wells began to operate. So, the Ishimbaev oil field was discovered, it was one of the largest one in Bashkiria. It was Bashkiria that became the main oil-producing region of the Volga-Ural basin before the Second World War. So, if in Bashkiria

in 1932 only 4 500 tons of oil were produced, then in 1937 it was produced 962 000 tons, and in 1939 it was produced 1 670 000 tons (Baibakov, 1984).

Thus, by the middle of 1930s, the Volga-Ural basin was rightfully considered an area suitable for industrial oil production. However, it was not possible to use its huge potential because of the fact that well drilling, according to the erroneous theory of the primary formation of oil fields, continued at shallow depths in Perm sandstones and carbon deposits. Supporters of Gubkin were not allowed to drill deeper. So, Gubkin's ideas in the Tuymazaneft trust (Bashkiria) were shared by I.V. Barrels. He proposed in 1938 to drill a Devon well with a design depth of 1 700 meters. However, upon reaching a depth of 1 500 meters, the leadership of the trust decided to stop drilling (Salimov, 2005).

With the outbreak of war, the country's leadership, desiring to sharply increase oil production, decided to develop the area of "second Baku". If during the pre-war five-year periods the development of the oil industry of the Volga-Ural basin accounted for 5-10 % of all investments in the oil industry of the USSR, then in 1942 the amount of capital expenditures for expanding the Volga-Ural basin amounted to 41.6 %, and in 1943 it amounted to 55.8 % of the all-Union investments in the oil industry (Budkov & Budkova, 1985). Nevertheless, this did not lead to positive results. According to the theory of primary occurrence of oil, the wells were drilled to a depth of not more than 1200 m for the exploitation of deposits of coal and Perm systems (Aliev & Shashin, 1968). As a result, only small industrial oil reserves with low well production rates (7-10 tons per day) were found there. As a result, in Bashkiria the largest oil producing region of the Ural-Volga region oil production in 1943 compared to 1940 was reduced by 2 times. In 1941-1943 only 5.7 million tons of oil was produced in the «second Baku», which amounted to only 7.8 % of the all-Union production, 73 million tons (Budkov & Budkova, 1985). This state of affairs led to the fact that many Soviet geologists began to doubt the prospects of the Volga-Ural basin. However, attempts by supporters of the theory of I.M. Gubkin to start drilling there on the Devon were still met with hostility by the leadership of the oil industry.

Devonian deposits were drilled in the Ural-Volga region due to the sluggishness of the suppliers. On December 1943, the team of the drilling master V. A. Rakov drilled a well № 41 in the area of the Apple Ravine (Kuibyshev region) to the design depth, laid in November of the same year as an operational coal-bearing Suite of the coal system. For start-up of wells in operation it is required of the casing. However, they have not had time to put before navigation on the Volga, the only way of delivery is stopped. It was necessary to wait for the beginning of summer navigation. During these few months, the condition of the wellbore, not strengthened by casing pipes, could significantly deteriorate, which would lead to the loss of the well itself. To prevent this situation, it was decided to transfer the well into the category of exploration and drill on Devon, deepening the trunk for another 500-700 m (Muradov, 1995). The decision was correct. On June 8, 1944 the well № 41 from a depth of 1478 m gave a fountain of oil with a flow rate of 485 tons per day (Takoev, 1995). This proved the industrial oil-bearing capacity of the Devonian deposits in the area between the Volga and the Urals and it was the beginning of large-scale drilling on Devon. As a result, if in 1943 the "second Baku" produced 1.95 million tons of oil (Budkov & Budkova, 1985), then in 1950 it produced 38 million tons (Baibakov, 1984).

Thus, due to the erroneous determination by Soviet geologists of the depths of the main oil reserves in the Ural-Volga region and their rejection of the hypothesis of academician I. M. Gubkin, the real opportunities available in the USSR for a sharp increase in oil production on the eve of the war were not realized during it. For the explosives industry, this meant limiting the raw material base of toluene, which had a negative impact on the supply of ammunition to the army (Grechko, 1947).

Another disadvantage of the oil industry, which affected the decline in oil production in 1941-1943, was the extensive nature of its development. This circumstance was explained both by the peculiarities of the oil production process and by the mismanagement of many managers of oil fields and trusts. It was preferable to drill new wells than the rational use of old ones. As a result, the funds allocated by the state for the overhaul of working wells and the equipment involved in them, were not mastered, and the wells were prematurely liquidated (Budkov & Budkova, 1985). This was typical for the main supplier of oil to the USSR in the pre-war years, for Baku oil region. Accordingly, not only the increase, but even the maintenance of oil production at the same level, was achieved there by putting into operation new wells. So, in 1941, new wells accounted about 16.1 % of all oil

produced (3.76 million tons). This allowed to exceed the 1940 level by only 6 % (1.3 million tons) (production increased from 22.2 to 23.5 million tons). Thus, if it was not for the commissioning of new wells, in 1941 oil in Baku would have been produced by 11.08 % (2.46 million tons) less than in 1940.

The significance of this factor was not considered at the beginning of the war, when the country's leadership, with the aim of boosting oil production in the Volga-Ural basin, decided to transfer some of the oil engineering enterprises there from Azerbaijan. In summer and in autumn it 1941 by the decision of Government Short-Term Commitments in the Urals-Volga region there was the evacuation of the Baku factories "Krasniy proletariy", "1 May," named in the honor of A. F. Myasnikov, F. E. Dzerzhinsky and I. V. Stalin, as well as the experimental office of turbine drilling (EOTD) and the trust "Aznefterazvedka" with all personnel, drilling equipment and tools. This weakened the oil industry of Azerbaijan. However, the factories remaining in its composition soon also ceased to serve the oil industry workers, switching to the production of military products. As a result, the production of equipment for the needs of the Baku oil fields in 1941 was significantly reduced, and in 1942 it almost completely stopped. The commissioning of new wells ceased, and oil production began to plummet.

The cessation of the production of oil equipment prevented not only the drilling of new wells, but also interfered with the ongoing and overhaul of old wells. The technical equipment of repair crews deteriorated; their number began to decline. For example, if in 1941 one repair team serviced an average of 17 wells, then in 1942 it had to service 42 ones (Madatov, 1975). Repairmen could not cope with the consequences of accidents common in the practice of oil production: breaks in pump rods and pipes, breakdowns of pumping units and group drives, damage to towers, ruptures of fountain valves, etc. As a result, downtime of existing wells has become more frequent.

The lack of repair equipment began to have a particularly severe effect at the end of 1942, which was associated with the withdrawal of Nazi army in the summer and autumn of that year to the Volga and the northern spurs of the Caucasus Range. The main railways and waterways, through which oil and oil products were transported from Baku, were cut. Interruptions in the operation of transport that could not cope with the export of finished petroleum products very quickly led to an overflow of available oil capacities and oil storage facilities. As a result, a number of wells had to be mothballed. A long shutdown of the wells led to their watering and the formation of plugs, which made it difficult to put them into operation and required serious repair work. The latter, in the absence of the necessary equipment, was impossible.

The main consequence of the weakening of the material and technical base of the Baku oil fields was a sharp drop in oil production there: from 23.5 million tons in 1941 to 11.8 million tons in 1944. Since the oil industry of the Volga-Ural basin could not cope with its tasks, Baku was still the main oil producing region in the USSR. As a result, oil production in the USSR also decreased a lot. If in 1941 the Soviet Union produced 33 million tons of oil, then in 1944 it produced only 18.3 million tons. This catastrophically did not correspond to the pre-war plans. So, in March, 1939, during the work of the 18th AUCPB congress, its participants worked out a resolution that provided for an increase in oil production up to 54 million tons already in 1942 (Decision of the party and government on economic issues, 1967).

In conditions of falling oil production, the annual consumption of about 14 million tons of oil in order to obtain pyrogenetic toluene became impossible. The main plants for the pyrolysis of oil products were located in the center of the country and therefore were not captured by the Nazis: oil and gas plant № 1 in Moscow, oil and gas plant № 2 in Gorky, factory in the honor of Budyonny in Baku and plant № 96 in the Gorky region. Their total capacity was 3 450 tons of toluene per month or 41 400 tons per year. However, due to the lack of kerosene, the enterprises worked at half-strength. Even in a fairly prosperous 1945, for the first five months these plants produced 6 275 tons of toluene, which amounted to 36.37 % of all the capacities they had (Leytman, 1947).

Conclusions

Thus, during the years of the Great Patriotic War, the production of the most important explosive for the Red Army, trotyl, was not provided in the required volumes with the necessary toluene for its manufacture. This forced the Soviet leadership to seek economic assistance from the USA, which, like the USSR, was interested in defeating fascist Germany. Already on November 7, 1941, American president Roosevelt extended the Lend-Lease Act to the

USSR, according to which all military goods delivered by the USA government to its allies and expended by them during the hostilities were free of charge.

The fuel base of the United States and the production of aromatic hydrocarbons, were incomparably more powerful than the fuel base of the USSR. So, for example, in 1942, oil production in the USA and the USSR amounted to 200 and 22 million tons, respectively (History of Second World War, 1947). Therefore, in the framework of Lend-Lease, the Americans provided invaluable assistance to the Soviet Union in the supply of both toluene (TNT was made from it at Soviet defense enterprises) and finished TNT (Table 2) (Leytman, 1947).

Table 2. The receipt of imported toluene and TNT in the USSR in 1941 – 1945

Year	Toluene received (in tons)	TNT received (in tons)
1941	1400	---
1942	12500	8577
1943	27400	19030
1944	24100	60919
1945	10000	28930
Total during the war:	75400	117456

In 1941-1944, Soviet troops received 403 350 tons of explosives, of which 384 572 tons or 95.3 % were TNT. There were 88 526 tons or 23 % of imported TNT. In addition, during the indicated period, the USA delivered 65 400 tons of toluene to the USSR. This amount of toluene was enough for the manufacture of 125 769 tons of TNT, which gives another 32.7 % (consumption coefficient of toluene is 0.52, that is, approximately 1.9 tons of TNT are obtained from a ton of toluene). Thus, during the years of Second World War, the Red Army's firepower was more than half ensured thanks to the supply of toluene and TNT from the USA to the USSR (55.7 % of the TNT received by Soviet army had the foreign origin) (Leytman, 1947). Without these supplies, successful combat operations of the Red Army against Nazi German forces would have become impossible, which would lead to a delay in hostilities and a sharp increase in casualties. During the Second World War, the USSR lost about 26.6 million people. However, these losses would have been even higher if it had not been for USA assistance to the Soviet Union in the supply of explosives.

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