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"FROM CHIPS TO PULP IN MINUTES": INNOVATIONS AND CONTINUOUS PULP COOKING IN THE SOVIET UNION IN THE 1940S-1950S[2]

The 1940s – mid-1960s saw rapid developments in the chemical and cellulose industries internationally. In this period, a number of attempts to introduce new technologies were taken by industrial scientists and engineers, some of which happened in different countries simultaneously. In the late 1930s, Swedish engineer Johan Richter proposed the Kamyr digester project to industrialists, and after roughly ten years it succeeded in implementing the technology at an industrial scale. Several years earlier, Soviet engineer Leonid Zherebov proposed a project different from the Swedish one in some technical parameters, but with the same purpose – increasing the production of pulp. This initiative, however, was not introduced as planned. Instead, after more than 20 years, Soviet industry mostly produced pulp using Kamyr digesters purchased from abroad. Following the question raised by historian Loren Graham as to why Russian innovations often remained isolated ideas, this article seeks to investigate the nature of Soviet innovation by examining Soviet modernization through a case study of continuous pulp cooking. It will focus not only on the technological specifics of the innovation, but on social and political conditions. In so doing, this paper will examine the activities of engineers and the interactions of institutions within the Soviet pulp and paper industry.

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Keywords: innovation, Soviet, technology, pulp and paper industry, technological development

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Introduction

In February 1956, Soviet leader Nikita Khrushchev initiated the de-Stalinization of Soviet society with his secret speech at the twentieth congress of the Communist Party. Several months later, the retired colonel Pravdenko, who was also trained as an engineer, sent a letter to a member of the Presidium of the Soviet Communist Party Mikhail Pervukhin. He said: "It is really depressing to realize that our Soviet industry is not capable of producing good tables, beds that will not creak at night, comfortable houses and other things." In his letter, he referred to Pervukhin`s presentation at the Congress, where he supported Khrushchev and criticized deficiencies in the organization of Soviet industry. Pravdenko stressed that the problem rested with a disorganized and irresponsible Soviet research and development sector. His observations were based on his experience with military aviation research and development. When it became possible to voice critiques, following Khrushchev's straightforward criticism of Stalin`s totalitarian rule, Pravdenko complained that scientists did not take care of launching innovations, but rather tried to conduct their research formally and just spend the money allocated by the state to research.[3]

There were, however, separate inventors who had motivation but suffered from a lack of financial and intellectual support opportunities to implement their ideas. Many talented innovators tabled their groundbreaking ideas due to a lack of state or industry support. Indeed, as the historian of technology Loren Graham has recently shown, Russian and Soviet history witnessed a lot of inspired innovators. However, such figures as Popov, Cherepanov, Prokhorov, Lebedev – people who developed the radio, steam engine, laser and computer – are not widely known for their inventions, since they were not transformed into successful industrial products. Instead, the Soviet state purchased analogous inventions from abroad or transferred foreign (primarily, Western) technologies in order to imitate and launch their own production.[4]

In the 1920s, philosopher Oswald Schpengler wrote, "The economic organizer, factory manager, engineer, inventor – these are not Russian types… Machine industry is its very nature "un-Russian" and will always be foreign to the Russians as something sinful."[5] However, the following history shows that there were many engineers and inventors, and during its history the Soviet government encouraged workers and engineers to engage in invention and rationalization.[6]Moreover, under communism, Russian industry experienced rapid development,

[3]Pis`mo leitenanta-inzhenera Pravdenko M. Pervukhinu (Letter by engineer lieutenant Pravdenko to M. Pervukhin)// RGAE (Russian State Archive of the Economy). F. 8513. Op. 1. D. 232. L. 101-105.
[4] Graham, *Lonely Ideas*.
[5] Schpengler, 'Das Doppelantlitz Russlands und die Deutsche Ostprobleme', 13-14.
[6] Schattenberg, "Stalins Ingenieure. Lebenswelten zwischen Technik und Terror in den 1930er Jahren".

and the Soviet regime was associated with quick industrialization and industrial projects on a large scale. Many innovators offered solutions to overcome critical problems in different technological systems - for example, improving separate parts in machinery or increasing the production of important materials. In the process of industrialization and modernization, a number of innovations were encouraged by the Soviet state, and these triggered the development of Soviet science and technology. But only few of them were successful projects – ideas which resulted in formidable technological discoveries and production, as in the case of Sergey Korolev and space engineering or Mikhail Kalashnikov and his assault rifle. Based on these examples, some historians have argued that mostly military projects supported by the state were able to succeed, since the state assessed research potential, finances and strict control and, thus, helped innovators (or even forced) them to build research teams and finally achieve success.[7] Indeed, the military sector was a rather unique field in the Soviet government: it had both financial support and coercion stemming from militarized Soviet foreign policy. Still, in the non-military sphere, there were innovators who were supported by the state but failed to introduce their ideas successfully, and instead they were forced to use foreign technology.

In order to comprehend the reasons why Soviet innovators failed, historians have offered various explanations. Kendall Bailes was among the first to pay attention to this question, and argued that "the barriers to successful innovation in terms of social relations of the technostructure [existed] both internally and in its dealing with other major groups of Soviet society."[8] She listed a comprehensive set of problems with technological innovations in the Stalinist period, such as an urgent need to adapt foreign technologies, the lack of competition, terror against some innovators, the ideological goal of stimulating technological innovation not only by intelligentsia, but by workers as well, the scarcity of skilled workers, the strong tradition of pure research, the organizational split between research, development and product, and, finally, weak influence of economists in innovations. The main reason, however, was found in the imbalance between production and industrial research, as many scientists conducted fundamental investigations which had a little connection with the practical industrial sector. Some of them presented double identity – they claimed to be in tune with the aims of the Soviet state, which often implied adopting Western technologies, and at the same time pursued their own interests.[9]

Adopting Western technologies as the easiest way to modernize and as evidence of Soviet path dependence was stressed by Anthony Sutton, the author of a monumental book on Soviet

[7] Graham, *Lonely Ideas*; Research under communism is considered thoroughly by Asif Siddiqi who focused on Germans worked in the post-war Soviet Union. Siddiqi, "Germans in Russia".
[8] Bailes, *Technology and Society under Lenin and Stalin*, 338.
[9] Ibid., 345.

technological development. He begins his analysis by contending that "no fundamental industrial innovation of Soviet origin has been identified in the Soviet Union between 1917 and 1965". Soviet innovations have consisted, in substance, in adopting those "made first outside the USSR or using those made by Western firms specifically for the Soviet Union and for Soviet industrial conditions and factor resource patterns".[10] This statement has a lot of truth to it, as technology transfer was very significant in Soviet development, and its role often implied the permanent need for foreign assistance. Even in the 1930s, the age of "high Stalinism" when the state was more closed ideologically, purchases of Western (firstly, American) technology and visiting foreign specialists played a large role in industrialization.[11] Western technologies were so widely used because they were cheaper and less time-consuming in the context of "catching up" the West.[12] Historian of economy Philip Hanson, however, argues that later between 1945 and 1958 Soviet imports were rather modest and the Soviets continued examining and copying already purchased equipment.[13] One way or another, many scholars see the progress of Soviet industry as largely dependent on Western innovation.

At the same time, the domestic policy of the Soviet regime had tragic implications for some innovators. In chronicling the life of railroad engineer Iurii Vladimirovich Lomonosov, historian Anthony Heywood shows how Lomonosov continued his valuable research in the early Soviet period, but in the 1920s had to search for ways to avoid arrest and immigrated abroad. To Soviet state, he was considered a "non-person," and if he did not escape, his life would have been similar to those of many repressed Soviet engineers. [14] So, in this story terror and ideology seem to be among the main reasons for why some engineers did not develop new products but for many years disappeared from the research life.[15]

More universal explanations are given in Graham's recent work "Lonely Ideas", which place the origin of technological failures in a social context. In particular, he argues that Russian/Soviet technological weakness was a result of misunderstanding or biased attitudes towards the role of innovations by Russian society. This is why reforming the technological sector required a fundamental structural transformation of society in order to make it more open to innovations, if not to say democratic.[16] In earlier works, Graham argued that excessive centralization in the Soviet Union lead to state support of research in the fundamentals of theoretical physics, mathematics and some other spheres, but did not maintain industrial

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[10] Sutton, *Western Technology and Soviet Economic Development*, xxv.
[11] Cohen, 'Circulatory Localities. The Example of Stalinism in the 1930s'.
[12] Sutton, *Western Technology and Soviet Economic Development,* xxv.
[13] Hanson, *The Rise and Fall of the Soviet Economy*, 61.
[14] Graham, *The Ghost of the Executed Engineer*.
[15] Heywood, *Engineer of Revolutionary Russia: Iurii V. Lomonosov (1876-1952) and the Railways,*
[16]Graham, *Lonely Ideas*.

investigations. This was the reason for a crucial gap between theory and practice, which developed separately.[17]

These historians present the interplay of many factors, illustrating a complicated picture of the inconsistencies between technological innovations and political and social development. Some stress the role of Western technologies, which were either the more accessible option or a basis for domestic innovations, or substituted for what were initially Soviet ideas. At the same time, explaining the specifics of innovations and development requires a deeper investigation into not only politics or scientists themselves, but also the process of translating their ideas into industrial production. This paper study is not just about inventing an innovation, but about implementing it in practice in order to see how practical science developed in the Soviet context. It will contribute to the existing scholarship on Soviet innovation by presenting the case of continuous pulp cooking, a technology developed by a scientist and then given to industrial engineers. This case was unique in terms of receiving strong state support, was even the object of great hopes from officials who worked in managing institutions. At the same time, the outcome of this story was typical of many other innovations in Russian history: the project was never introduced, and Soviet industry had to use Western technology instead. In addressing the question of why Russian innovations have failed historically, my paper, will consider a case where industry attempted to translate an original theoretical idea into an industrial application. In addition, this study will examine the development of the pulp industry, a field still marginal in the historiography of technology. It will consider the question in an interdisciplinary perspective, referring to the ensemble of social and political factors that accompanied technological innovation. It will also address the larger international context, looking at the development of similar technology in other countries as well as technology transfers, in order to show the connections between industrial sectors of East and West.

The discovery of continuous pulp cooking was closely connected with the rapid development of the chemical and construction industries in the late nineteenth and early twentieth centuries. The invention of new chemicals enabled producers to manufacture new types of cellulose and, as a consequence, produce various types of paper and cardboard. In the 1920s and 1930s and in particular during and after the Second World War, the cellulose industry in many countries was developed intensively. Prior to WWII, there were revolutionary initiatives to improve complicated bleaching and washing technologies for cellulose. Following the war, the industry saw changes in the automation of technological processes and in technology. As a result, in the post-war years, the output of the pulp and paper industry increased radically.[18] Put

[17] Graham, *Science in Russia and the Soviet Union*, 180.
[18] Riche, 'Impact of Automation in the Pulp and Paper Industry, 1947-1960,' 1114.

simply, better organization and technology allowed for the production of whiter and firmer paper and cardboard, and more of the qualified pulp required for other industries, such as food, textiles, and the military. Developing new types of pulp and paper, as well as increasing their quality, were the consequence of societal change and expanding consumer demands. Thus, in the early twentieth century pulp, was in demand to manufacture paper for a society with a rapidly expanding literate population and growing print industry. The world wars opened up new opportunities as the military became a significant consumer of pulp, required for the making of ammunition, gun powder, and rubber for aviation.

In the first half of the twentieth century, pulp cooking was the basic method used to transform wood chips (wood run through a shredder) into pulp in a digester, and was universally done by batch method. As a result, only a certain amount of pulp could be cooked, as the digester worked for several hours to complete all the stages of cooking in sequence. Generally, this method was not economical, was time-consuming, and had a negative impact on the quality of pulp mass. In addition, after each batch cooked, the digester – a complicated and expensive apparatus - required basic maintenance and more often broke down. The problems associated with this method were quite obvious, and industrial scientists in several countries put in considerable effort to develop more functional systems. Batch cooking, thus, was a critical problem which hampered the development of the whole technological system.[19]

However, the existing equipment could not continuously cook wood chips into pulp, since the digesters designed for batch preparation could not operate all the stages of cooking process at once. Overcoming the critical problem meant inventing a new digester that could cook pulp faster. In the early 1930s, engineers in several countries began to develop such a construction and to work on changing the existing method of pulp making into a more efficient version by introducing continuous cooking. Unlike batch cooking, the new method allowed for nonstop cooking with the steady and simultaneous addition of wood chips and unloading of finished pulp mass. The goal was to make the process of cooking pulp easier and faster, transforming chips into pulp in a matter of minutes.[20] The first attempts were made in Sweden and the Soviet Union, followed by imitations and the development already-in-use (Swedish) technology in Finland, USA, Canada, and Australia.

In the first part of the article, I will give a brief overview of how continuous cooking was introduced in Sweden and the activities of Johan Richter as an example of a successful industrial project, as well as examine briefly the Western context of inventing and launching this technology in Finland and other countries. Then, I will focus on the Soviet case, examining the

[19] Hughes, *Networks of Power*, 79-80.
[20] 'From Chips to Pulp in Minutes,' 8.

activities of Soviet engineer Leonid Petrovich Zherebov and his invention. Finally, in the conclusion, I will offer some explanations for technological failures in the Soviet Union.

Successful story

Continuous pulp cooking in Sweden and other countries

If one comes to a cellulose factory or research institute in Europe or the United States and pronounce the name of Johan Richter, any experienced engineer will say that he was the father of the modern cellulose industry. Richter was a Norwegian-born engineer and an inventor of the continuous pulp cooking method. His success began with another innovation - the invention of bleaching pulp by continuous process, which made it easier to refine cooked wood chips and produce whiter pulp. This bleached pulp was an important material, and allowed for the production of better-quality paper and other cellulose-based products.

In the late 1920s, Richter worked in cooperation with the Norwegian industrialist Knud Dahl from the Myrens Mechanical Workshop. In 1920, Dahl had founded a cellulose and paper business called Kamyr together with the Karlstad Mekaniska Werkstad in the Swedish town of Karlstad.[21] The union between Richter and Dahl resulted in successful innovations in bleaching pulp. In the terminology of historian of technology Thomas Hughes, Richter and Dahl - as well as other engineers and scientists working in the group – were system builders, who tried to overcome a critical problem in order to improve the performance of the pulp industry.[22] Their project was fulfilled in the mid-1930s and enabled the company to enlarge significantly afterwards. After successful experiments with bleaching, Richter began to develop similar methods for cooking, which was a more complicated process than making pulp whiter. In 1938, Kamyr constructed an experimental digester, and ten years later continuous cooking was launched in the industrial scale in a kraft mill at Fengerfors in Central Sweden.

The key to continuous digester operation was in creating the technology to feed the digester at high pressure, which enabled adding wood chips without mechanical damage or a serious loss of steam.[23] The digester consisted of several zones, in which various stages of cooking were done simultaneously and, thus, could produce more pulp.

In its first iterations, the maximum capacity of the new digester was slightly more than 100 tons of cellulose and contained some technical weaknesses. The invention as such was not

[21] Kamyr's name originated from two companies: AB Karlstads Mekaniska Werkstad of Sweden and Myrens Verkstad of Norway.
[22] Hughes, 'The Evolution of Large Technological Systems,' 52
[23] Toivanen, *Learning and Corporate Strategy*, 209.

sufficient to change the industry, but rather required further development of the technology over the next ten years. Answering the skepticism of other specialists, Richter said that “People used to ask the same question when we started to make bleaching continuous, and look what they are buying now, all of them.”[24] Indeed, despite the small capacity and a number of critical problems in the construction, the digester was a promising innovation in pulp production. In the context of increasing need for pulp by different industries, the continuous method seemed to be an important technology. In the late 1940s – mid 1950s several companies from different countries purchased the Kamyr`s apparatus. Scientists and industrialists in other countries continued improving the digester, often in contact with Kamyr. To some extent, perfecting continuous cooking was a collective effort, as many industrialists worked together on improvements. Others tried to work by their own, based on a purchased digester and aimed to create similar appliances. Thus, there were later attempts to launch an analogous innovation, undertaken by American companies Esco and Pandia (the Division of the Black-Clawson Company), Australian APPM and others, which managed to introduce various kinds of digesters with different applications, most of which were basically modifications of Kamyr.[25]

One of the first Kamyr-digesters outside Sweden was set in Finland in 1952 by the company Joutseno Pulp OY and had a capacity of 120 tons. Joutseno`s engineers took part in experiments in the USA initiated by the Technical Association of the Pulp and Paper Industry. In addition, these experiments were conducted in close cooperation with Kamyr and French mills at Condat.[26] The main technical problem in the construction of the digester was the heating system, since the apparatus had to work at high temperature without stopping to cool. Another Finnish company Ahlström OY which had been a partner of Kamyr conducted similar experiments and offered its solution to the problem. [27] These experiments helped invent the cold blow, to cool the pulp while washing debris from the cooked mass. Later, a Canadian mill in Port-Melon launched a digester with another method called “Hi-Heat Washing” that also solved the problem with heating. In total, accumulated experience lead to the diffusion of improvements to different aspects of one technology. As Sven Rydhom, an engineer who conducted the experiment at the Technical Association said, he paid his respects “not only to Kamyr men but to all pioneers of continuous cooking working in the industry who have carried the double burden of technical difficulties of development.”[28] By the mid-1960s, the cellulose sector used several modifications

[24] Rydholm, *Continuous Pulping Processes*, 3.
[25] An overview of circulation of pulp cooking technologies (including improving batch cooking) in the nineteenth century is given in Burke, ‘Wood Pulp, Water Pollution, and Advertising,’ 179.
[26] Rydholm, *Continuous Pulping Processes*, 7.
[27] Laakso, *Modeling of Chip Bed Backing in a Continuous Kraft Cooking Digester*, 19.
[28] Rydholm, *Continuous Pulping Processes*, 10.

of Kamyr digesters which differed slightly in methods of blowdown, washing the mass and other technological features.

Among the efforts to construct new digesters, the Kamyr Company, retained its place as the leading international supplier of continuous cookers. In particular, the company established a North America-based affiliated company Kamyr Inc. in 1953 to supply the North American market. By the late 1950s a number of American factories were equipped by digesters for continuous cooking.[29] In the mid-1960s, there were 16 digesters, several of which had a significant capacity, some up to 750 tons a day.[30] Kamyr, thus, managed to leave its competitors behind, although some analogous digesters were constructed and improvements of the initial digester were made in cooperation with foreign companies. Richter had an excellent research and administrative career, serving as executive director of Kamyr until 1959, when he moved to the position of technical advisor for more than thirty years.

Soviet experiments

Leonid Zherebov and his method of cooking cellulose

In 1956, Soviet writer Vladimir Dudintsev published his widely famous "Not by Bread Alone" which told about engineer Lopatkin who tried to launch the production of pipes for the chemical industry, - an unprecedented invention, but one faced with hostility and an impenetrable bureaucracy.[31] The hero of this paper - Leonid Petrovich Zherebov faced different conditions, gaining the support of the government and state industrial leadership in his attempt to implement his invention, continuous cooking of pulp. This project was developed slightly earlier than the similar innovation by Richter, and seems to have emerged in isolation from the Swedish experiments.

Zherebov was born in tsarist Russia in 1863. He graduated from Moscow University and gained his first professional experience at a paper factory in Kamensk, and afterwards worked as a director of this enterprise. Some years later he continued his education at the Moscow Higher Technical School, moving away from practical work as he devoted his time to theoretical examinations of timber as a material for producing of paper and pulp. In the Soviet period, he was among those researchers who continued to work under the Bolsheviks, managing to build an excellent career and escape the repressions of the late 1930s. During these years he received patents for his inventions and founded several educational and research organizations. For

[29] Toivanen, *Learning and Corporate Strategy*, 210.
[30] Nepenin, *Varka sul`fatnoi tsellulozy v ustanovkakh tipa Kamyr*, 9.
[31] Dudintsev, *Ne khlebom edinym*.

example, in 1926 he received a patent for receiving galipot from resinous wood, a project he had finished in 1915. [32]

The list of his achievements under the Soviet government appears formidable: in 1919 he was a co-founder of Moscow Institute of Forestry Engineering; nine years later he acted as one of founders of the All-Union Research Institute of Timber, which afterwards was divided into several other institutions, such as the Central Research Institute of Paper, the Central Research Institute of Forestry, and the Central Research Institute of Wood Machining. In the 1920s, he was involved in the reform of science initiated by Bolshevik`s leadership, which included the creation of research establishments.[33] In 1938, Zherebov became the head of the All-Union Engineer Community of Workers of the Paper Industry. He received many awards for his theoretical work and research activities, in particular the Order of Lenin and Order of the Red Banner of Labor for deeds to the Soviet state and society. In 1965, in the volume celebrating the hundredth anniversary of his birth, his students and colleagues wrote that his life "was full of creative search which all was aimed to develop paper and cellulose, hydrolyzed, and wood chemical industry." [34] One of the authors of this volume, K. Veinov, wrote that "he had always been a voice of innovative scientific ideas, and in his research he was ahead of his time". [35]

Indeed, Zherebov developed different aspects of wood chemistry, and found extensive use for wood in industrial productions, among other accomplishments. One of his major and well known inventions was a method for the continuous cooking of pulp, which he proposed in the late 1920s - early 1930s. This was a period when the Soviet government tried to launch new technologies and industries, as well as significantly increase the production of pulp and paper. While the same search was happening in other counties, in the USSR the problem of pulp production was considered urgent on the state level. Despite huge forests, the Soviet pulp and paper industry processed only five percent of cut trees while the American industry used 35 and Canadian 40 percent of wood.[36] In the late 1920s, some large pulp and paper-making plants were constructed (for example in Kondopoga in the North-Western part of the country), but their capacity was not enough. The need to increase the output of pulp-based products was clearly articulated as a priority for the economic development of the country.

Building new plants was an important part of this process, and large-scale enterprises were constructed – including Vishery in 1931, Maryisk in 1938, Segezha in 1939, Solikamsk in

[32] *Baza patentov SSSR.*
[33] Graham, *Science in Russia and the Soviet Union*, 174.
[34] *L.P. Zherebov (K 100-letiu so dnya rozhdenia)*, 2.
[35] Ibid., 2-3.
[36] Doklad GNTK SM SSSR "O sostoianii i tekhnicheskom urovne tsellulozno-bumazhnoi promyshlennosti", 20.09.1957 (Report by the State Committee on Science and Technology "On the pulp and paper industry and its technical level", 20.09.1957) // RGAE. F. 9480. Op. 3. D. 1154.L. 57.

1941. These enterprises launched the construction of new cities and industrial areas. Their capacity, however, did not match that of the rapidly developing international pulp and paper industry. It was clear that improving already-in-use technologies would be more efficient than extensive enlarging of production and building new plants. As a result, introducing intensive methods of pulp production was taken as a priority and encouraged by the state officials. New enlargement was, however, made after the Second World War when several updated enterprises were annexed by the Soviet Union in the Baltic States and Finland. For instance, the Finnish territory of Karelian Isthmus and Ladoga Karelia, which became part of the Soviet Union in 1944, included several pulp, paper making and wood working enterprises.[37] Some authors contend that the Soviet leadership initiated the war with Finland in order to annex this geopolitical region, since it could provide the USSR with a buffer zone as well as with modern industrial potential.[38] However, because the war caused a significant damage and the Finns evacuated most of their machinery (which was returned gradually after the war), the annexation did not bring an automatic improvement of the Soviet pulp and paper industry.

Zherebov`s method of continuous cooking have been appropriate for intensification of pulp production and met the requirements of the day. His innovation was in moving raw materials through the digester from top to bottom, with the ability to regulate the temperature of cooking throughout the whole height of the apparatus. Like Richter`s construction, Zherebov`s digester enabled fast production and high-quality pulp. Both new digesters would be easier to operate, while investments to produce pulp would be lower. In addition, last but not least, the hidden meaning of this innovation, in particular in the Soviet context, might be connected with military purposes, namely for production of ammunition. This aim was not explicitly articulated in the sources I had, and it is more probable that historians can reveal this information from classified documents in later research.

The key difference in two inventions was technical, related to the time of mass moving through the digester. Another distinction was hidden in the time needed for cooking; in Zherebov`s model it would have taken just 15 and 20 minutes, and, thus, produce more pulp under 200 – 220 C^0. To compare, Kamyr required about 60 – 90 minutes while batch cooking was processed under 170 degrees and took about 300 minutes to produce cellulose in one

[37] A comprehensive list of Soviet pulp and paper enterprises in different regions is given in Barr and Brenton, ‘Regional Variation in Soviet Pulp and Paper Production,’ 47-48. The authors counted that of 186 plants working in 1965, thirty seven had moved to the Soviet Union between 1940 and 1945 as the result of territorial expansion in the Baltic States, Kaliningrad, areas annexed from Finland, and the Sakhalin region.

[38] Kilin, *Karelia v politike sovetskogo gosudarstva*, 42. Yri Kilin argues that the war with Finland was initiated by the Soviet government because of two reasons: it wanted the Finns not to enter into alliance with Germany and annex the Finnish territory near the Leningrad military district.

digester.[39] Technologically, Zherebov`s method was thus of a more revolutionary character than Richter`s since it was possible to change the cooking time, temperature and reagent concentration in different parts of the digester and have the full digester working at maximum speed.

Continuous cooking required more qualified raw materials and sophisticated exploitation of equipment. However, the invention could satisfy two needs of the Soviet government: it solved the problem of insufficient and bad quality pulp as well as the shortage of labor, since the new technology could help reduce the number of workers needed in a pulp factory.[40] Batch cooking did not allow engineers, research institutions and, finally, the main consumer of pulp, the Soviet state, to fulfill set aims and norms of production. It hampered the development of pulp and, as a consequence, paper and cardboard production as well as other civilian and military industries. Batch cooking did not meet growing consumption requirements, a problem that the large capacity of continuous cooking digesters could solve. Therefore, Zherebov offered a promising innovation, one which could help improve the performance of pulp production as a technological system.

In the 1930, the Soviet government paid close attention to the practical application of scientific research and the development of innovations. In the post-war period, this politics was even more significantly stressed by the Soviet leadership. In 1959, for example, on the twentieth first congress of the Communist Party it was said that "it was necessary to build stronger connections between scientific research and practice, apply newest innovations of science and technology into the industry, and conduct more experimental and constructional work." [41] But even earlier, Soviet political leaders aimed to make the country the leading inventor in the world. [42] Zherebov`s invention was potentially an important step in fulfilling this task.

Not surprisingly, his innovation was supported by officials at the highest level. Thus, in decrees issued by the head of the Ministry of Pulp and Paper Industry of the USSR Leonid Grachev, Zherebov`s continuous cooking digester was referred to as "the most valuable invention for cellulose industry" and "the towering achievement of a Soviet scientist".[43]

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[39] M. Serdiukov, M. Popov, A. Vasilenko. Dokladnaya zapiska po voprosu o nepreryvnoi varke tsellulozy na Svetogorskom ZBK Ministerstva bumazhnoi i derevoobrabatyvaiushchei promyshlennosti, 1956 god (Report on continuous pulp cooking in the Svetogorsk pulp and paper plant of the Ministry of Paper and Wood Processing Industry)// RGAE. F. 9480. Op. 2. D. 146. L. 5-6.

[40] Reducing labor was a logical outcome of automation of industrial production in all over the world. The mid-twentieth century witnessed a rapid automation in many fields, the process closely connected with the development of computers and cybernetics.

[41] *Vneocherednoy XXI s`ezd Kommunisticheskoi partii Sovetskogo Souiza*, 440.

[42] Bailes, *Technology and Society under Lenin and Stalin*, 343.

[43] Prikaz Ministerstva tselluloznoi i bumazhnoi promyshlennosti SSSR ot 6 dekabria 1947 goda (Decree by the Ministry of Pulp and Paper Industry of the USSR issued on 6 December 1947)// LOGAV. F. R-

Zherebov could offer a project which did not require significant justification by the state or institutions responsible for research and development. Unlike Dudintsev`s hero, he did not need to knock at the doors or beg anyone to accept his ideas. In opposite, Zherebov was a person recommended by many organizations and had several important theoretical works known among specialists.

Implementing Zherebov`s method and technology transfer

The initial experiments made by Zherebov were quite successful: first, on the Moscow Central Heating and Power Plant and then at the Dobrushsky Pulp and Paper Plant in Belorussia in 1936. He constructed an experimental digester which produced pulp of good quality via continuous cooking. The following history shows a break of nine years when the question about the industrial launch of the cooker seems to have been forgotten. The reason might be found in the context of WWII, since military actions in Soviet territory resulted in immense damage to factories, research institutions, and left industry in disarray even after the war's end. The destiny of the experimental digester seems to be unknown, but it is probable that it was lost or deconstructed in the war period.

Two years after the war, the Ministry of Pulp and Paper Industry published a decree devoted to Zherebov`s innovation. It stated that now "it was urgent to create an experimental digester for continuous cooking of pulp", and then put the experiment into industrial production.[44] For these purposes, the Ministry allocated some finances or 490 thousand rubles in order to save on production afterwards.[45] If Richter gained support from a private company, Zherebov`s idea was, thus, supported by the state officials which would play a leading role in controlling the implementation of continuous cooking in the Soviet Union.

For example, the location for the first industrial production of pulp by continuous cooking was selected by the Ministry. It was the Enso (in 1951 its name was changed to Russian *Svetogorsk*) pulp and paper plant, located on the border with Finland and annexed by the Soviet

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180. Op. 1. D. 7. L. 27; Prikaz Ministra tselluloznoi i bumazhnoi promyshlennosti (Decree of the Minister of Pulp and Paper Industry)// LOGAV. F. R-180. Op. 1. D. 13. L. 42. The Ministry of Pulp and Paper Industry was reorganized in 1948 when it was unified with the Ministry of the Forestry Industry into the Ministry of Forestry and Paper Industry until 1951. Then a new Ministry of Paper and Wood Processing Ministry was created.

[44] Prikaz Ministerstva tselluloznoi i bumazhnoi promyshlennosi SSSR on 6 dekabria 1947 goda (Decree by the Ministry of Pulp and Paper Industry of the USSR issued on 6 December1947)// LOGAV. F. R-180. Op. 1. D. 7. L. 25.

[45] Perechen` stroitel`stva ustanovok po nepreryvnoi varok i nepreryvnomu gidrolizu (List of facilities for continuous pulp cooking and continuous hydrolysis)// LOGAV. F. R-180. F. 1. L. 24.

Union after the Finnish-Soviet war in 1944. This plant was chosen because of its capacity and comparatively modern equipment, as the former owner of the plant - Finnish company Enso-Gutzeit OY – completed a basic renovation of the facilities shortly before the war. As a result, in the late 1930s, it was the largest producer of pulp in Europe, and its machines were among the most modernized on the continent. It was the most updated plant in the Soviet Union, despite all new enterprises constructed in the previous decade.[46]

The responsibilities for introducing continuous cooking were put on the local administration. However, in post-war Enso, the intentions of Moscow did not produce strong enthusiasm, since they required as finding qualified engineers and proper raw materials. After the enterprise was annexed by the Soviet Union, Finland returned evacuated equipment, but there was still a large problem with setting this and finding additional equipment and engineers capable of working with the new machinery. In addition, damaged equipment required maintenance, but not all the parts and components were manufactured in the Soviet Union. The first Soviet chemical machinery parts factories were launched in the late 1920s, but they could produce only simple machines. In 1930, a factory in the Ukrainian republic of Nikolaev, produced first domestic pulp digesters, which were installed in new pulp and paper plants, most of which had already been equipped with foreign machinery. In 1934, the factories of the Central Administration of the Chemical Industry in Suma and Kiev began the production of digesters and furnaces on the basis of foreign companies and "foreign professional literature."[47]

Concerning technical expertise, there was a technical college founded in Svetogorsk, the settlement nearby (later, an industrial town), but teaching required skilled professionals. Most lecturers came from the enterprise and university establishments in Leningrad, the city that also delivered newly minted engineers to the plant. In this sense, Leningrad with its industrial base was considered a center compared to the peripheral Enso/Svetogorsk. The local engineers, in particular those who worked in the scientific-technical society (nauchno-tekhnicheskoe obschestvo) had some ties with Leningrad`s organizations, for example the All-Union Institute of Paper. Such establishments were voluntary organizations in many plants with a general aim of assisting in technological progress and improving production. However, the society of Enso/Svetogorsk is rarely present in the factor's records, and it is probable that its role was minor. In plant`s entire archival collection, I found only a few reports of this organization devoted to the separate aspects of pulp and paper production. It is also remarkable that Zherebov

[46] Laine, 'Modernization in the 1940s and 1950s in the Part of Karelia that Was Annexed from Finland on 13 March 1940', 29.

[47] Vybor obosnovania konstruktsi i tipov vysokoproizvoditel`nogo oborudovania dlia proizvodstva polutsellulozy i tsellulozy iz trostnika (Choosing the construction and types of highly-efficient equipment for making semi-pulp and pulp from reeds)// RGAE. F. 9480. Op. 3. D. 1178. L. 68-69.

did not teach in Svetogorsk, nor did he come to the plant frequently. I could not find any sign of his presence in the local materials, which might be explained by his age (in 1947 he already was 84 years old), other personal reasons, or his devotion to very theoretical work. Again, the main task of practical implementation was given to local engineers and also to specialists who worked on Zherebov's research board, which took control over implementation.

The main reason of why the project was not introduced in 1947 as was initially planned in the decree of the Ministry was due to a lack of technical specifications and equipment. The Ministry board blamed the factory's leadership, claiming that they had an irresponsible attitude towards the project, i.e. "the most significant innovation of the Soviet science." In addition, the head of the Central Administration of the Sulphite Cellulose Industry (which was a body in the Ministry responsible for implementing the method) Malytin wrote to the head of the plant Sergey Puzyrev that "to a large extent, the delay in implementation of continuous pulp cooking is happening because of you." Malytin specified that Puzyrev did "not take any concrete measures to order the equipment."[48] Puzyrev explained that he was not able to find the appropriate technical parts as they were not produced in the Soviet Union and it was impossible to purchase them from abroad. In fact, the factory requested permission to import appropriate equipment from Finland, which had tight trade connections with the Soviet Union despite the Cold War. However, purchasing parts from abroad was not a simple task and required involvement of the State Committee on Science and Technology of the Soviet Union and organizations of foreign trade. Moreover, finding the parts required identifying appropriate suppliers by examining foreign professional literature, addressing those engineers who went abroad for research trips or requesting foreign companies, and finally negotiating with foreign partners on the inter-state level. Getting parts thus included all levels of the government and negotiating, then waiting for the parts to be delivered according to the specifics of trade treaties. In total, all these stages meant ordering equipment and could take several years.

I could not find any data about where the technical parts were received from exactly, although there were a number of supplies of foreign equipment to the Enso plant. The local acts on deliveries of foreign equipment are quite fragmentary and do not always indicate the country of origin. There were, however, mechanisms for cooking and washing of pulp which appeared in the documentation of accepted equipment.[49] Only in 1950 were the tools for an experimental digester received, but their launch was delayed because there were necessary parts missing, in particular high-heat pumps. In October 1950, the Minister issued a new decree where he

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[48] Pis`mo i.o. nachal`nika Glavsul`fittsellulozy Maluitina direktoru Enso, 1947 (Letter to the associate director of Glavsulphittselluloza Maliutin to the head of Enso)// LOGAV. F. R-180. Op. 1. D. 11. L. 4.
[49] Akty po priemke importnogo oborudovania (Lists of received foreign equipment)// LOGAV. F. R-180. Op. 4. D. 57. L. 60, 77, 91.

complained that the work of implementing continuous pulp cooking was being fulfilled at an "impossibly slow pace".[50] The head of the plant Alexander Sil`chenko, who succeeded Puzyrev, said that "the plant was not blame." He specified that there was now a problem with expertise, as the skilled engineers in the plant as well as the workers lacked training in continuous cooking and simply did not know what to do with the new equipment.[51] Another difficulty was in the lack of raw materials or chipped wood of proper quality. In addition, an anonymous report on Zherebov`s digester observed that "there was no any sign of motivated research."[52] The document argued that there was no research plan, and, as a result, the cooker was not discussed anywhere. At the same time, there was another reason of why just a few people worked on the project. As engineers worked in the group on continuous cooking complained, "The digester was a secret project, and it was not discussed widely by other researchers. There was a narrow circle of people who solved all the questions."[53] Indeed, in trying to launch a revolutionary technology, the Ministry leadership was eager to keep the digester a secret. This might explain why even despite having no resources for the development of the technology, the Ministry did not seek foreign expertise openly. Instead, during the first three years of the project, all responsibility was put on domestic potential – specifically, on a small group of engineers working in the plant. It included at least the head of the plant and the chief engineer as well as a few other engineers specialized in pulp cooking processes.

The group had connections with the Zherebov`s development laboratory in Moscow which was mostly dealing with theoretical improvements to the initial project. In the early 1950s, a specialist from the laboratory Khutolev came to the plant, but his participation, as some local engineers complained, was not active enough.[54] In the same year, the administration of the plant initiated an agreement with the Leningrad branch of the Research Institute of Chemical Machinery in order to find help in implementing Zherebov`s project. However, engineers of the plant were refused, as the institute said that they did not have specialists able to fulfill the task.[55]

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[50] Prikaz ministra lesnoi i bumazhnoi promyshlennosti SSSR ot 16.10.1950 g. (Decree by the Minister of Forestry and Paper Industry of the USSR, issued on 16 October 1950)// LOGAV. F. R-180. Op. 1. D. 15. L. 6.

[51] Pis`mo direktora Svetogorskogo TSBK A. Sil`chenko zamestiteliu nachalnika Glavtsellulozy P.N. Alekseevu, 1950 g. (Letter by the head of the Svetogorsky Pulp and Paper Plant A. Sil`chenko to the associate director of Glavtselluloza, 1950) // LOGAV. F. R-180. Op. 2. D. 20. L. 16.

[52] Otchet ob osvoenii i eksperimental`nykh ispytaniiakh opytnoi ustanovki dlia nepreryvnoi varki (Report on implementing and experiments on continuous pulp cooking)// LOGAV. F. R-180. Op. 4. D. 331. L. 10.

[53] Ibid.

[54] Protokol soveshchania pri zamestitele ministra K.A. Veinove, 1953 g. (Protocol of the meeting held by deputy minister K.A. Veinov in 1953) // LOGAV. F. R-180. Op. 1. D. 25. L. 8.

[55] Pis`mo nachal`niku inspektsii pri Ministerstve lesnoi i bumazhnoi promyshlennosti SSSR Nikiforovu ot direktora Enso A. Sil`chenko on 4 dekabria 1950 goda (Letter to the head of the inspection of the

At the same time, some sources illustrate that slightly later this institute did work on continuous cooking, based on the experience of Finnish industry.[56] It is probable that this story illustrates the competition between different institutions in the Soviet Union, and specialists of the research institute, not responsible for implementing Zherebov`s method, did not feel obliged to share their experience with the Enso plant. It undoubtedly indicates strong barriers between research boards and industrial enterprises.[57]

Engineers of the plant tried to find specialized literature on continuous cooking, as the local library was not equipped with technical information on the method. It seems probable that papers published by Richter were not easily accessible, although engineers of Svetogorsk were aware about the inventor and his work. Despite the fact that the Enso project was supported at the highest level, the plant did not receive many detailed materials or instructions on Zherebov`s method. The documentation given by Zherebov`s research board was enough to explain the basic principles of his complicated technological process, but could not provide the answers to specific questions appeared in the process. In 1951, in a secret letter to the head of the Central Research Institute of Paper S. Puzyrev, Sil`chenko wrote that from all the materials on continuous cooking "there was only a project of installation of digester and a short technical description.[58] Using his position as the head of the plant he asked for the loan or purchase of technical literature on continuous cooking. In particular, he asked about articles by Richter which, as he assumed, should have been in the institute's collection.[59] The answer from Puzyrev was rather astonishing; he indicated that there was translation of a paper by Richter and Otto on continuous cooking, but the relevant literature could not be sent. The reason, Puzyrev explained, was that the work required was only a single copy, while all the typewriters were busy and could not make a copy.[60] As a result, it was only possible to read the book in the reading room of the library instead. I cannot say if Sil`chenko finally found the articles elsewhere or managed to get a copy

Ministry of Forestry and Paper Industry of the USSR Nikiforov sent by the head of Enso A. Sil`chenko, 4th December, 1950)// LOGAV. F. R-180. Op. 2. D. 20. L. 33.

[56] Otchet o komandirovke L.A. Mazina (Report on the business trip by L.A. Mazin)// RGAE. F. 9480. Op. 7. D. 925. L. 103.

[57] There were more indications about these obstacles in communication between research and industry. Thus, Kamsky paper plant had been initially constructed on the basis of plans proposed by Giprobum – the head institution to construct industrial objects in the Soviet Union. However, as the first head of the plant M. Eliashberg said, in this plan there were many significant mistakes. While constructing, even though some basic constructions were already made, while implementing the offered plan the engineers decided to work out a new one, actually not referring to Giprobum. See *Kamskomu kombinatu 20 let*, 63.

[58] Sekretnoe pis`mo A. Sil`chenko direktoru TSNIIB Minlesbumproma SSSR S.A. Puzyrevu, 1951 god (Secret letter by A. Sil`chenko to the head of the Central Institute of Paper of the Ministry of Forestry and Paper Industry S.A. Puzyrev)// LOGAV. F. R-180. Op. 2. D. 15. L. 1.

[59] Ibid.

[60] Pis`mo direktora TSNIIB Minlesbumproma SSSR S.A. Puzyreva direktoru Enso A. Sil`chenko (Letter by the head of the Central Institute of Paper of the Ministry of Forestry and Paper Industry S. Puzyrev to the head of Enso A. Sil`chenko)// LOGAV. F. R-180. Op. 2. D. 15. L. 2.

from the institute`s library, but this story illustrates how strong and obvious the divides were between the institutions.

All this produced delays in launching the digester, first to the late 1951, then to 1952. During the summer of 1951, the engineer-in-chief of the plant Konstantin Malyshkin corresponded with the Central Administration of Sulphite Cellulose Industry complaining about the lack of the machinery and electrical equipment needed for the upper section of the digester, despite regular requests to the central offices for industrial management.[61] The typical answer he received said that "there is no facilities in the warehouses" and at the same time a contradicting statement "take decisive measures to finish the works."[62]

The digester was finally completed in December 1952, but its functioning revealed some defects, mostly because of improper assembly. In particular, the testing devices did not work correctly because of mistakes made while it was being installed. The head of the State Committee on Science and Technology, an organization responsible for science and development in the Soviet Union, wrote that "control of machinery was mostly done by eye and depended on the qualification and experience of operating personnel.[63] In 1953, the plant received additional funding of four hundred thousand rubles and in the following year, one hundred thousand more to finish the project and start industrial production.[64] In 1953, Malyshkin wrote to the Ministry that the digester was checked and installed, but again described technical problems.[65] In the following two years, engineers were involved in repair and attempts to overcome deficiencies in the equipment. The engineers also complained that the main reason for failures was because there was not space enough for the equipment, and they had to change the specifications of the initial project.[66]

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[61] Pis`mo glavnogo inzhenera K. Malyshkina i.o. nachal`nika Glavtsellulozy Minlesbumproma SSSR E.A. Kuznetsovu, 1951 god (Letter by the engineer-in-chief K. Malyshkin to the vice-director of Glavtselluloza of the Ministry of Forestry and Paper Industry E.A. Kuznetsov)// LOGAV. F. R-180. Op. 2. D. 15. L. 7.

[62] Pis`mo nachal`nika Glavtsellulozy M. Serdiukova glavnomu inzheneru K. Malyshkinu (Letter by the head of Glavtselluloza M. Serdiukov to the engineer-in-chief K. Malyshkin)// LOGAV. F. R-180. Op. 2. D. 15. L. 8.

[63] Spravka o tekhnicheskom urovne tekhnologii proizvodstva na TSBP, 1957 (Summary of the technical level of production in pulp and paper enterprises)// RGAE. F. 9480. Op. 2. D. 40.

[64] Perechen` stroitel`stva ustanovok po nepreryvnoi varke i nepreryvnomu gidrolizu, 1953 – 1955 gg. (List of facilities for continuous pulp cooking and continuous hydrolysis) // LOGAV. F. R-180. Op. 1. D. 24.

[65] Pis`mo glavnogo inzhenera Malyshkina ministru bumazhnoi i derevoobrabatuvaiushchi promyshlennosti K.A. Veinovu, 1953 god (Letter by the engineer-in-chief Malyshkin to the Minister of Paper and Timber Industry K.A. Veinov, 1953)// LOGAV. F. R-180. Op. 1. D. 25. L. 1.

[66] Otchet ob osvoenii i eksperimental`nukh ispytaniakh opytnoi ustanovki dli nepreryvnoi varki (Report on implementing and experiments on continuous pulp cooking)// LOGAV. F. R-180. Op. 4. D. 331. L. 4, 8.

In 1955, the Zherebov`s digester was ready and continuous cooking as an industrial process was launched at the Enso plant. The process was now successful in terms of the technical stages. In the early 1956, a joint research group of engineers from the State Committee on Science and Technology, Ministry of Machine Making and Ministry of Paper and Wood-Working Industry traveled to the plant to check the digester. They concluded that construction was done mostly on the basis of existing materials taken from Svetogorsk: for example, three air funnels were borrowed from the other factories of the plant. The quality of pulp was low and did not meet the standards.[67] The delegates decreed that the digester had to be fixed in May 1956, but it was now important to introduce and investigate the continuous cooking digesters already invented and implemented in Sweden and Finland. They recommended the engineers in Svetogorsk intensify their study of a Kamyr digester already purchased from Finland in 1955, installed but still not functioning in the Marysky pulp and paper plant – one of the most updated Soviet enterprises, but located quite far from Svetogorsk, 50 km from Kazan. The committee said that it was now urgent to travel to Finland in order to examine their digesters and speed the research in the Soviet Union based on Western experience. It was also important, they said, to send some experienced engineers from Svetogorsk to the Marysky plant in other to assist launching a Kamyr digester there. Then, "it was needed to investigate thoroughly this digester and transform this experience into Zherebov`s parameters.[68] Last, they stressed the need to create proper conditions for delay-free deliveries of raw materials to Svetogorsk.

This trip to check the plant seems to be among the last attempts from the leadership to introduce Zherebov`s method, and shows the turn on the part of the Ministry and related institutions toward transferring foreign technologies instead of developing domestic variants. A year before, in 1955, the Kamyr installation was purchased by the Soviet Union, its investigation was included into the chief plan of development and implementation of techniques.[69] The purchase of foreign digesters was evidence of path dependence and the result of the need to rapidly modernize the industry. This aim was officially stated by the post-Stalin leadership in 1955, but met the earlier requirements of the state.[70]

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[67] M. Serdiukov, M. Popov, A. Vasilenko. Dokladnaya zapiska po voprosu o nepreryvnoi varke tsellulozy na Svetogorskom ZBK Ministerstva bumazhnoi i derevoobrabatyvaiushchei promyshlennosti, 1956 god (Report on continuous pulp cooking in the Svetogorsk pulp and paper plant of the Ministry of Paper and Wood Processing Industry)// RGAE. F. 9480. Op. 2. D. 146. L. 5-6.
[68] Ibid., 7.
[69] Pis`mo zampreda Gostekhniki Y. Maksareva v SM SSSR, 14.3.56 (Letter of the vice-director of Gostekhnika Y. Maksarev to the Council of Ministers of the USSR, 14th March 1956)// RGAE. F. 9480. Op. 2. D. 146. L. 9.
[70]*Kommunisticheskaya partia Sovetskogo Souiza v rezolutsiakh i reshenizkh s`ezdov, konferentsii i plenumov TsK*, 506.

We may assume that there were several trips to Finnish and Swedish factories in order to learn continuous cooking methods more thoroughly. Such trips were mostly organized in the early Khrushchev period, which allowed more freedom in relations between East and West, and when some Soviet scientists and engineers went abroad for short trips. Most of these trips were made within agreements on scientific-technical and cultural cooperation with foreign countries, signed in the years after Khrushchev came to power, right before and during formal destalinization. For instance, in 1955, the Soviet leadership signed an agreement on cooperation in science and technology with Finland which entailed trips of Soviet engineers to Finnish enterprises and research organizations. In 1957, a group of engineers headed by I.A. Khodakov visited enterprises in Finland and Kamyr Company in Sweden. In their report, they described the principles of continuous cooking and stressed that Kamyr digesters were not perfect technologically, but quite popular among producers in various countries.[71] Three years later, a group of engineers from the Balakhna pulp and paper plant was sent to Finland. After spending two weeks in Finnish factories these engineers projected continuous cooking in Balakhna, and the experiments were probably conducted with the Kamyr digester already set there. As the Soviet delegates reported, they could implement some aspects of technologies transferred from Finland and thus reduce time of cooking pulp. In addition, after their return, they organized a large industrial conference, hosting engineers from across the country in order to discuss Finnish experience in continuous cooking. These engineers, thus, acquired the status of experts and of discoverers of a new technological world. Some engineers of Svetogorsk, including V. Sykol, Z. Danilin and V. Malyshev took part in this event, saying in their report that the conference provided valuable expertise and enabled them to improve some elements of Zherebov`s machine.[72]

At the same time, by the mid-1960s the Kamyr digesters with the capacity of up to 300 tons of pulp a day had already been used in several Soviet enterprises, although some industrial research was conducted later. Thus, in 1966, the docent of the S.M. Kirov Forest Academy in Leningrad and specialist of the Research Institute of Information and Technical-Economic Research on Forestry, Pulp- and Paper, Timber Industry and Silviculture Yri Nepenin published an overview of continuous cooking by Kamyr machines based on his travel to the Marysky plant. He grounded his analysis on the inspection of the digester and compared it with data drawn from

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[71] *Nepreryvnaia varka sufatnoi tselliulozy i polutselluilozy*, M., 1958.
[72] Rekomendatsii nauchno-tekhnicheskogo soveshchiania po voprosu uluchshenia kachestva sul`fitnoi viskoznoi tsellulozy, sozvannogo GKNT SM SSSR i NTO bumazhnoi i derevopererabatyvaiuchshei promyshlennosti, 1960 g. (Recommendations of scientific-technical meeting on improving the quality of sulpfite viscose pulp held by the State Committee on Science and Technology of the USSR and scientific-technical society of paper and timber industry)// GARF. F. 409. Op. 1. D. 1190. L. 140.

articles published in foreign professional journals available in the Soviet Union. He stressed that in 1966 there were three working Kamyr digesters in the Soviet Union: in Marysky, Segazha and Kotlass plants. In his view, among all these enterprises, only the Marysky one had a possibility to use proper wood chips, while the others did not receive material of good quality. Wood chips, however, were the most important components in cooking pulp and had influence on the cooking process and the quality of the pulp mass. Chips had to be of uniform size between 15 and 20 centimeters, and have a minimal percentage of sawdust, bark and decay.[73] Nepenin stressed fairly that this had a negative impact on the mass and improper work of the digesters as well as required the reorganization in the work of enterprises responsible for supplies of wood chips.

In the early 1960s, some other Soviet plants used digesters of different construction - modifications and analogous of Kamyr as well as alternative constructions also purchased from abroad. In particular, in 1962 a digester Pandia delivered by Parsons and Whittemore was used in the Chersonese pulp and paper enterprise in Crimea. Like Kamyr`s digester, this apparatus was thoroughly investigated by Soviet engineers, in particular after some defects were revealed.[74] Local engineers replaced few technical components (feeders) with those produced in the Soviet Union because of splits, while the digester itself was rusted.[75] By the 1960s, thus, some replacement parts and modifications were already produced in the Soviet Union - however, it is not easy to say what mechanisms were still missing in the Soviet machinery production industry.

The destiny of Zherebov`s method in Svetogorsk was finally achieved in the mid-1950s, when industrial production by continuous cooking was launched. At that time the digester produced only 50 tons of pulp a day, a very small output.[76] Local engineers continued to experiment independently, not under the strong supervision of the responsible Ministry as before. The urgent state need to introduce the technology and produce better pulp had been fulfilled by using and improving upon foreign equipment while the domestic project failed to play a leading role in pulp production.

The mid-1950s was the time when different institutions were involved in the implementation of Zherebov`s method, publicly presented some general conclusions on the project. The reason was probably connected with that a Kamyr digester was transferred to the Soviet industry or at least this invention was now known in the USSR. In May, 1955 at the meeting of the Central Administration of Sulphite Cellulose Industry, vice-chairman P. Alekseev said that "it took more than twenty years to realize the idea of continuous cooking. The main

[73] Nepenin, *Varka Sul`fatnoi Tsellulozy v ustanovkakh tipa Kamyr*, 17.
[74] Tarasiuk, *Osvoenie varochnogo apparata Pandia na Khersonskom tselluloznom zavode*, 3.
[75] Ibid., 22.
[76] Osanov, 'Metod skoroi nepreruvnoi varki tsellulozy,' 47.

reason of that long implementation is a lack of attention from the Ministry".[77] A year later, the State Committee on New Techniques met and reported to the Council of Ministers that the Ministry of Paper and Wood-Working Industry lagged behind in introducing new techniques. They admitted that twenty years ago Zherebov`s method was presented to the Moscow branch of the Central Research Institute of Pulp and Paper when there was no analogous research abroad. They stressed that the Ministry issued more than twenty decrees on the method, as well as included it to the state plan on techniques five times, and the total cost of the project was more than 20 millions of rubles, but all this had a zero effect.[78] In addition, they stressed that in the 1950s, simultaneous with attempts to implement the method in Enso/Svetogorsk, similar research was launched abroad, and became widespread in Sweden, Finland and the United States.[79]

In these two conclusions, we see responsibility put on the Ministry for its inability to supervise research, as well as the idea that Zherebov`s method came earlier than more successful foreign experiments. Accusing administrators of institutions, ministries or enterprises was a typical strategy in the industrial field and reproduced the idea of bureaucratic irresponsibility.[80] In this story, indeed, we see that the role of the Ministry in charge of the digesters was limited by decrees and resolutions, while the special board of the Central Administration of Sulphite Cellulose Industry should have provided expert and technical assistance. In many cases, however, neither this organization, nor the research office of Zherebov provided much assistance to the Enso/Svetogorsk engineers.

Despite the factual failure of the project, Zherebov was still considered a significant Soviet inventor and author of an excellent idea. Even before his death in 1958, various institutions published volumes devoted to his professional life. Some engineers, again, stressed that his ideas were introduced earlier than similar concepts in other countries,[81] while others argued that his innovation was adopted if not stolen by foreign engineers who could successfully adapt it for industrial production.[82] Zherebov had lived a long life, and was undoubtedly a

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[77] Protokoly i reshchenia rasshirennogo zasedania Tekhnicheskogo soveta po nepreryvnoi varke, 31.05.1955 (Protocols and desicions of the extended meeting of the Technical council on continuous cooking, 31st May 1955)// LOGAV. F. R-180. Op. 4. D. 332. L. 38.

[78] This number of decrees is probable, although I found only five. The sum spent for the project might also be true, but the sources use in this article show it to be much lesser. This letter saying about the results of the meeting does not provide more detailed data, other than final figures.

[79] Pis`mo zampreda Gostekhniki U. Maksareva v SM SSSR, 14 marta 1956 goda (Letter of the vice-director of Gostekhnika Y. Maksarev to the Council of Ministers of the USSR, 14th March 1956)// RGAE. F. 9480. Op. 2. D. 146. L. 9.

[80] Kochetkova, 'Modernizatsia sovetskoi tsellulosno-bumazhnoi promyshlennosti i transfer tekhnologi v 1953-1964 godakh: sluchai Enso-Svetogorska.'

[81] Alekseev, 'Sozdatel` metoda nepreryvnoi varki,' 78.

[82] Maliutin, 'Sovremennoe konstruktivnoe reshchenie nepreryvnoi varki tsellulozy,' 82.

brilliant researcher, theoretician, and a significant contributor to the Soviet pulp and paper industry. His activities established different institutions, produce excellent research on different aspects of wood processing, but his invention in pulp cooking was not realized as was expected.

Conclusions

Today the largest part of world pulp is made by continuous cooking. Although the batch method is still used by few enterprises, it is widely recognized as less economical than continuous pulping. The latter was a project initiated and improved in several countries in the 1930s, but the most recognizable inventor was Johan Richter, now considered the father of modern pulp industry.

The activities of Richer in Sweden in preparing and implementing the continuous cooker design were made in concert with the industrial company Kamyr, and after about ten years resulted in successful mass production. The outcome was a digester model purchased by many foreign countries and improved upon by engineers from different organizations. To some extent, this was a collective project, derived from close cooperation between Kamyr and Finnish, American and some other companies. At the same time, Richer's project launched many imitators and modifications among a number of foreign firms (such as Pandia). These projects, however, were not commonly used, and today Kamyr digesters produce 2/3 of all world pulp.[83]

In the Soviet Union, slightly earlier than Richter`s idea, an even more technically ambitious digester was designed by engineer Leonid Zherebov. It seems that there were no close contacts among two inventors, and there were no interactions between Zherebov and other foreign engineers. Zherebov`s method was supported by the Soviet state, represented by the administration of the pulp and paper industry, which aimed to increase the production of high-quality pulp. Zherebov's innovation was monopolized and politicized by the state, which took all control of implementation of the invention made secret. The digester constructed by Zherebov was to be set in Enso/Svetogorsk pulp and paper plant, a former Finnish enterprise which was the most updated among Soviet plants right before the war. The Ministry put the responsibility on the plant's engineers, despite their lack adequate parts (mostly not produced in the Soviet Union) and expertise due to problems with educating specialists in continuous cooking. The shortage of parts and knowledge on how to work with the new digester, as well as the problems with supply

[83] Ivanov, *Sovremennye sposoby varki sul`fatnoi tselliulozy*, 49.

of proper raw materials, were among the crucial difficulties in implementing Zherebov's design. The difficulty, thus, was not a matter of technical parameters themselves: the Kamyr digester was a complicated and problematic construction as well, and took more than ten years to be completed. In this respect, successful implementation depended on building a network of connections between research and production, ties necessary for the exchange of information, financial support and acquiring of equipment and technical details. The innovation exemplified that the process from innovation to industrial production and from testing to technological adjustments was lengthy. It required what Thomas Hughes observed about large technological systems, which attracted many actors in building the network. The Soviet pulp industry required a large network, ideally including engineers of Enso/Svetogorsk working in concert with Zherebov`s research board, other research institutions and industrial plants. In practice, however, we see disorder in the network, mostly of organizational character.

One of the crucial reasons of failure laid in superfluous centralization of research. The state, through its ministries, took total control over implementation, from setting deadlines to the financial stimulation. The latter was important but not enough because many components of the system ranging from technical details to expertise were impossible to acquire.

Another reason of failure was created by strong barriers between different institutions within one technological space. This can be explained by competition between organizations which did not cooperate on the same project, but rather tried to make their own separately. Even on the scale of one country, there were separate and basically isolated endeavors both to work out new a Soviet method for pulp production usually built on Western experience. This might be the consequence of the secret character of the innovation in Enso/Svetogorsk which meant that the project was known only by a small group of engineers. At the same time, unlike the development of atomic bomb, a secret project which mobilized all necessary resources, in case of continuous cooking there was not a single leading expert but rather group of experts with different backgrounds. Engineers of the plant, however, tried to break the informational isolation by sending requests for cooperation, literature exchange and technical support with other institutions, but usually they were refused because of institutional barriers. In the history of continuous pulping we see competition arising from the different ministerial affiliations of the plants involved. In addition, there were several trips of engineers to plants in Finland and probably other counties including Sweden, in order to investigate foreign experience, and there were Kamyr and Pandia digesters bought and investigated in different Soviet factories. This was, however, a scattered effort with unconnected results, usually achieved by installing foreign equipment. In this respect, this story illustrates the path dependence of Soviet innovations and the typical result – switching to imports of similar technologies rather than using domestically designed variants.[84] The internal organization of the Soviet system as well as poor international connections created weak information flows. Both the Soviet way of management and Cold War import restrictions created informational isolation and lack of cooperation. At the same time both the Soviet leadership and Cold War aims explained the need of forced modernization and innovation.

Institutional obstacles also illustrate a significant gap between theory and practice when theoretical ideas were taken as a completed project ready for practical use. To a certain extent it was a culmination of long-time debates took place among scientists and engineers in many countries on the difference between theory and practice.[85] In reality, however, implementing Zherebov`s innovation proves the connection between further academic research and developments in practice. The analysis of this article illustrated what Kendall Bailes said about scientists who came to factories from time to time in order to give instructions and left soon thereafter.[86]

As a result, the implementation of Soviet continuous cooking took more than twenty years to develop, but unlike Kamyr`s (similarly long) experiment, it was not a successful part of industrial production. As a consequence, the analogous Western invention, first of all implemented by Kamyr, was widely adopted in the Soviet pulp and paper industry. The case of Zherebov`s method of continuous cooking shows the difficulties in overcoming reverse salients using domestic resources. Zherebov, who produced excellent theoretical work, did not participate fully in the industrial application of his design. The task was given to the engineers at the plant, without a strong technological or methodological support. After the first Kamyr and Pandia digesters were purchased and installed in Soviet enterprises, Soviet engineers, no longer suppressed by decrees, became (or at least tried to become) part of the international community of experts improving continuous pulp cooking. They examined foreign experience and developed to overcome some critical problems of the originally Swedish invention used in Soviet paper production.

In the late 1950s, Soviet industry experienced a large-scale economic increase. This euphoria made it possible to imagine that the country would enter the communism in a couple of decades and definitely surpass the United States technologically. In 1961, this purpose was articulated clearly in a new party program.[87] However, as the historian Philip Hanson stresses, until the 1970s the Soviet economy was rarely described as in crisis.[88] This was true for the

[84] Hedlund, *Russian Path Dependence*.
[85] Harwood, 'Engineering Education between Science and Practice: Rethinking the Historiography,' 54.
[86]Bailes, *Technology and Society under Lenin and Stalin*, 371.
[87] Chubarov, *Russia`s Bitter Path to Modernity*, 139.
[88] Hanson, *The Rise and Fall of the Soviet Economy*, 1.

military sector, but for many other fields, the flip side to the booming economy was the poor quality of products, technological backwardness, and extensive production. In the pulp and paper industry, this problem remained during the period of 1930s-1950s and arguably continues into the present.

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