ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)

2022 • 1

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ

БАЯНДАМАЛАРЫ

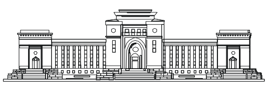
ДОКЛАДЫ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

REPORTS

OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN

PUBLISHED SINCE JANUARY 1944



ALMATY, NAS RK

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ

БАЯНДАМАЛАРЫ

2022 • 1

«Қазақстан Республикасы Ұлттық ғылым академиясының баяндамалары»
ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)
Меншіктеуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» Республикалық қоғамдық бірлестігі (Алматы қ.). Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ93VPY00025418** мерзімдік басылым тіркеуіне қойылу туралы куәлік.
Тақырыптық бағыты: *өсімдік шаруашылығы, экология және медицина саласындағы биотехнология және физика ғылымдары.*
Мерзімділігі: жылына 4 рет.
Тиражы: 300 дана.
Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28; 219 бөл.; тел.: 272-13-19
http://reports-science.kz/index.php/en/archive

Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

ДОКЛАДЫ **2022 • 1**

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

Доклады Национальной академии наук Республики Казахстан»
ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)
Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы). Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ93VPY00025418,** выданное 29.07.2020 г.
Тематическая направленность: *биотехнология в области растениеводства, экологии, медицины и физические науки.*
Периодичность: 4 раз в год.
Тираж: 300 экземпляров
Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28; ком. 219; тел. 272-13-19
http://reports-science.kz/index.php/en/archive

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

REPORTS **2022 • 1**
OF NATIONAL ACADEMY OF SCIENCES OF THE
REPUBLIC OF KAZAKHSTAN

Reports of the National Academy of Sciences of the Republic of Kazakhstan.
ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)
Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty). The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ93VPY00025418,** issued 29.07.2020.
Thematic scope: *biotechnology in the field of crop research, ecology and medicine and physical sciences.*
Periodicity: 4 times a year.
Circulation: 300 copies.
Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19
http://reports-science.kz/index.php/en/archive

Address of printing house: ST «Aruna», 75, Muratbayev str., Almaty.

**REPORTS OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
ISSN 2224-5227**
Volume 1, Number 341 (2022), 64-71 https://doi.org/10.32014/2022.2518-1483.134

UDC66.011
IRSTI87.35.91

Z.I. Jamalova[1], B.M. Kaldybayeva[1*], S.A. Boldyryev[2], D.M. Kenzhebekov[1]

[1]M. Auezov South Kazakhstan University, Shymkent, Kazakhstan;
[2]National ResearchTomsk Polytechnic University, Research School of Chemical and Biomedical Technologies, Tomsk, Russia.
E-mail: kaldybaeva.b@mail.ru

METHODOLOGY FOR BUILDING MODELS AND OPTIMIZING TECHNOLOGICAL PROCESSES USING P-GRAPH SOFTWARE

Abstract. The work is aimed at developing a methodology for assessing and optimizing the flows of basic resources at the regional level, in terms of minimizing the load on both the resource base and the environment. The objects of production / consumption of resources in the region that should be taken into account include end users (local residents), municipal users, as well as enterprises of industries with significant resource saving potential: metallurgy, chemical industry, production of building materials, mechanical engineering, petrochemicals, paper production, textile industry and so on.The purpose of the work is to find a fundamental compromise between expanding opportunities and increasing losses with closer joint use of basic resources, taking into account the desire to minimize anthropogenic impact on the environment. The proposed approach, based on a joint numerical analysis of resource flows, can be generalized to the case of complex management of other resources (raw materials, etc.). Environmental impacts are quantified by assessing the environmental footprint of issuers. The method provides for the possibility of adding additional necessary aspects of environmental impact in order to ensure its application for a wider range of practical problems. Assessment of resource efficiency and the level of environmental impact is carried out based on the analysis of the life cycle after determining the spatial boundaries and stages of the evolution of the system.An algorithm has been developed for controlling the heat and water supply of the region for the optimal combination of production / consumption of energy and water, both within clusters (districts) and at the level of inter-cluster interaction, minimizing residual resource imbalances and long-term impact on the environment.

Key words: optimization of resource use, process integration, energy efficiency, resource conservation, systems analysis, circular economy, digital transformation, sustainable development.

З.И. Джамалова[1], Б.М. Калдыбаева[1*], С.А. Болдырев[2], Д.М. Кенжебеков[1]

[1]М. Ауезов атындағы Оңтүстік Қазақстан университеті, Шымкент, Қазақстан;
[2]Томск политехникалыкҰлттық зерттеу университеті, Химиялық және биомедициналық технологиялар ғылыми мектебі, Томск, Ресей.
E-mail: kaldybaeva.b@mail.ru

P-GRAPHПРОГРАММАСЫНҚОЛДАНУУШІНМОДЕЛДЕРҚҰРУЖӘНЕ ТЕХНОЛОГИЯЛЫҚ ПРОЦЕССТЕРДІ ОҢТАЙЛАНДЫРУ ӘДІСТЕМЕСІ

Аннотация. Жұмыс ресурстық базаға да, қоршаған ортаға да жүктемені барынша азайту тұрғысынан аймақтық деңгейдегі негізгі ресурстар ағындарын бағалау мен оңтайландыру әдістемесін әзірлеуге бағытталған. Аймақтағы ресурстарды өндіру / тұтыну объектілеріне соңғы пайдаланушылар (жергілікті тұрғындар), муниципалды пайдаланушылар, сондай -ақ ресурстарды үнемдейтін әлеуеті бар салалардың кәсіпорындары жатады: металлургия, химия өнеркәсібі, құрылыс материалдары өндірісі, машина жасау, мұнай химиясы, қағаз өндірісі, тоқыма өнеркәсібі және т.б.Жұмыстың мақсаты - қоршаған ортаға антропогендік әсерді барынша азайтуға деген ұмтылысты ескере отырып, мүмкіндіктерді кеңейту мен негізгі ресурстарды бірігіп пайдалану арқылы шығындарды ұлғайту арасындағы түбегейлі ымыраға келу.Ресурстар ағынының бірлескен сандық талдауына негізделген ұсынылған тәсілді басқа ресурстарды (шикізат және т.б.) кешенді басқару жағдайына жалпылауға болады. Қоршаған ортаға әсер ету эмитенттердің экологиялық ізін бағалау арқылы анықталады.Бұл әдіс қоршаған ортаға әсер етудің қосымша қажетті аспектілерін оның практикалық мәселелердің кең ауқымында қолданылуын қамтамасыз ету үшін қосу мүмкіндігін қарастырады. Ресурстардың тиімділігі мен қоршаған ортаға әсер ету деңгейін бағалау жүйенің кеңістіктік шекаралары мен даму кезеңдерін анықтағаннан кейін өмірлік циклді талдау негізінде жүзеге асырылады.Кластерлерде (аудандарда) да, кластераралық өзара әрекеттесу деңгейінде де энергия мен суды өндірудің / тұтынудың оңтайлы үйлесуі үшін ресурстардың қалдық теңгерімсіздігін барынша азайту үшін облыстың жылу және сумен жабдықтауды басқару алгоритмі әзірленді. -қоршаған ортаға әсер ету мерзімі.

Түйін сөздер: ресурстарды пайдалануды оңтайландыру, процестерді біріктіру, энергия тиімділігі, ресурстарды үнемдеу, жүйелерді талдау, айналмалы экономика, цифрлық трансформация, тұрақты даму.

З.И. Джамалова[1], Б.М. Калдыбаева[1*], С.А. Болдырев[2], Д.М. Кенжебеков[1]

[1]Южно-Казахстанский университет им. М. Ауезова, Шымкент, Казахстан;
[2]Национальный исследовательский Томский политехнический университет, Научная школа химических и биомедицинских технологии, Томск, Россия.
E-mail: kaldybaeva.b@mail.ru

МЕТОДОЛОГИЯ ПОСТРОЕНИЯ МОДЕЛЕЙ И ОПТИМИЗАЦИИ ТЕХНОЛОГИЧЕСКИЕ ПРОЦЕССЫ С ИСПОЛЬЗОВАНИЕМ ПРОГРАММНОГО ОБЕСПЕЧЕНИЯ P-GRAPH

Аннотация. Работа направлена на разработку методологии оценки и оптимизации потоков основных ресурсов на региональном уровне, с точки зрения минимизации нагрузки, как на ресурсную базу, так и окружающую среду. К объектам производства/потребления ресурсов в регионе, которые следует учитывать, относятся конечные потребители (местные жители), муниципальные пользователи, а также предприятия отраслей со значительным потенциалом ресурсосбережения: металлургия, химическая промышленность, производство строительных материалов, машиностроение, нефтехимия, производство бумаги, текстильная промышленность и так далее. Цель работы – заключается в поиске фундаментального компромисса между расширением возможностей и увеличением потерь при более тесном совместном использовании основных ресурсов, с учетом стремления к минимизации антропогенного влияния на окружающую среду. Предлагаемый подход, основанный на совместном численном анализе ресурсных потоков, может быть обобщен на случай комплексного управления другими ресурсами (сырьевыми и т.п.). Воздействие на окружающую среду количественно определяется путем оценки экологических следов эмитентов. Метод предусматривает возможность добавления дополнительных необходимых аспектов воздействия на окружающую среду, чтобы обеспечить его применение для более широкого спектра практических задач. Оценка эффективности ресурсов и уровень воздействия на окружающую среду выполняется на основе анализа жизненного цикла после определения пространственных границ и этапов эволюции системы. Разработан алгоритм управления тепло-водоснабжением региона для оптимального сочетания объектов производства/потребления энергии и воды как внутри кластеров (районов), так и на уровне меж кластерного взаимодействия, минимизации остаточных дисбалансов ресурсов и долгосрочного воздействия на окружающую среду.

Ключевые слова: оптимизация использования ресурсов, интеграция процессов, энергоэффетивность, ресурсосбережение, системный анализ, экономика замкнутого цикла, цифровая трансформация, устойчивое развитие.

Introduction. One of the most important problems of modern society is the irrational use of energy resources. The constant increase in the use of fossil energy sources has led to one of the most important problems of the 21st century. - global warming [1]. Despite the constant increase in the share of renewable energy sources (RES) in the energy sector [2], this problem continues to be relevant [3]. This is partly due to the inefficient use of energy and water resources in the manufacturing sector [4]. The study [5] proposes the integration of calcium recycling into the lime production cycle at a pulp and paper mill. This reduces CO2 emissions from waste heat boilers and biomass power boilers [6].

The approach to designing an optimal and environmentally friendly energy system with decentralized energy generation for the municipal level is considered in the study [7]. The approach is to apply the clustering method together with the energy system modeling and cost optimization method. The main problem in the existing systems of distribution of energy resources between generating capacities and consumers is an ineffective system of distribution of flows between sources and their consumers [8,9]. To solve this issue, a visual diagram was designed for the distribution of heat energy and hot water to the consumer network, which was implemented in the P-graph environment program. To optimize the creation or operation of cogeneration and trigeneration systems, both exergy analysis [10] and mathematical programming methods [11] are used. For example, for the synthesis of optimal cogeneration and trigeneration systems, scientists [12] use fuzzy P-Graph. This allows to increase the economic efficiency of the developed systems in comparison with the use of MILP or P-Graph models.

To maximize the potential for the use of resources (raw materials, energy, water), inter-production integration is necessary. Utilization of low-grade heat by reducing primary energy consumption is a promising way to reduce the ecological footprint of enterprises [13-15]. For example, in the study [16], it is proposed to use a power plant, which makes it possible to comprehensively utilize waste from oil and gas enterprises. However, a common methodology is needed to maximize the potential for energy efficiency improvements in territorial production complexes. This methodology is Total Site Integration [17]. This methodology has been used in the oil refining [18], petrochemical [19], cement [20] industries.

Materials and research methods. Drag and Drop Material. As an example of sources of heat energy and hot water for the scheme, 4 boiler houses and 1 CHP and 4 consumers of these resources were given.

To describe the sources of «resources / materials», the operator «Drag and Drop Material» is set graphically, the graphic image and the main characteristics of which are shown in Figure 1. It should be noted that various physical parameters are used as «resources / materials» in this scheme, such as energy, consumption, volume, power, etc., which will be discussed below. The main parameters to be set are the name of the element (Name), the price per unit (Price), the required material consumption (Req.Flow) per unit of time, the maximum flow through this element per year (Max.Flow) is set by analogy with Req. Flow.

The type of resource / material (Quantity Type) is set in the window Object Properties → Parameters. In the pop-up window opposite the Quantity Type, select the required resource. P-graph allows you to operate with volumetric, quantitative energy costs.

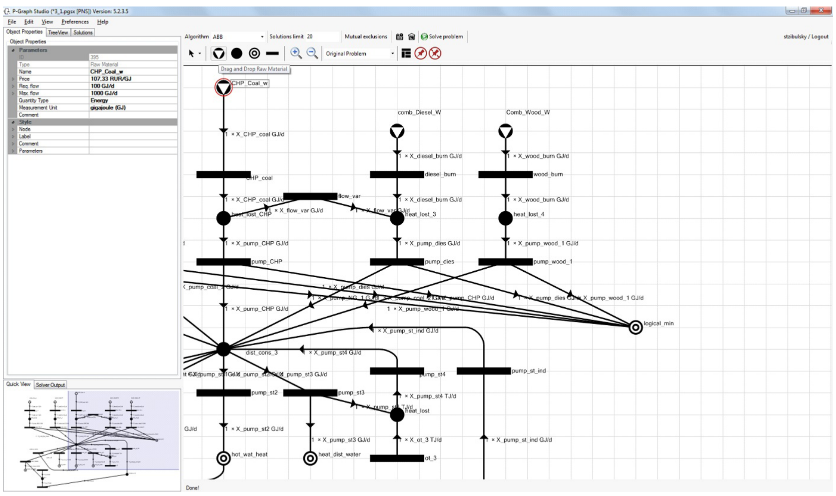


Figure 1 - Operator for source material

This object describes the quantity and cost of the product obtained at the source. In our case, the initial type of raw material is heat energy, the parameters of which are determined by choosing «Energy». Thermal energy is generated by 5 sources: comb_NG_w - boiler house burning natural gas, comb_Coal_w - boiler house burning coal, CHP_Coal_w - CHP plant burning coal, comb_Diesel_w - standby boiler house working on diesel, Comb_Wood_w - boiler house burning coal, Comb_Wood_w - boiler house burning coal.

For a boiler plant that burns fuel, the general form of the equation for determining the fuel consumption is as follows:

$$B_Т = Q_{КУ}/Q^Р_Н \cdot \eta_{КУ}, \qquad (1)$$

where: $\eta_{КУ}$ - efficiency for modern boilers burning natural gas, fuel oil, unit efficiency can reach 0.85 - 0.9. For current calculations, the efficiency of a boiler plant operating on coal and wood is assumed to be 80%, on gas, fuel oil and diesel fuel - 88%. $Q^{P}_{Н}$ - the lowest heat of combustion of fuel, for solid and liquid fuels - kg, for gaseous - m3, composition and lower heat of combustion of various fuels, $Q_{КУ}$ - set heat output of the boiler plant GJ/day.

The composition and thermotechnical characteristics of the combustible mass of the types of fuel, the composition and heat of combustion of combustible gases are determined from the reference data [21].

After determining the fuel consumption at the boiler plant according to the formula (1) for a given thermal power, it is possible to estimate the cost of the sold product:

$$c_{Т} = B_{Т} \cdot Ц_{Т} / Q_{КУ}, \qquad (2)$$

where: $Ц_{Т}$- the price of feedstock, tg/kg, $Ц_{Т(УГ)}$ - for coal, tg/kg, $Ц_{Т(Пр.\ г)}$ - for natural gas, tg/m3, $Ц_{Т(Др.)}$ - for firewood, tg/kg, $Ц_{Т(Д.т.)}$ - for technical diesel fuel, tg/kg.

A thermal power plant operating on coal and supplying thermal energy to the network in the form of hot water in the retro- and future have averaged indicators of specific consumption of equivalent fuel for energy generation in the country. From the analysis, it can be concluded that the dynamics of the decrease in the specific consumption of equivalent fuel ($Q^{P}_{Н(УСЛ)}$ = 29.33 MJ/kg ct) for the generation of electric and heat energy from year to year. For the current 2020, the specific consumption of equivalent fuel for the generation of heat energy was adopted - 158 kg/Gcal.

The conversion of the specific consumption of standard fuel to the specific consumption of hard coal per GJ is given in expression 3:

$$b_{К.У}^{ТЭЦ} = b_{УСЛ} \cdot Q^{P}_{Н(УСЛ)} / (Q^{P}_{Н(К.У.)} \cdot 4{,}1868), \qquad (3)$$

where: 4.1868 is the energy conversion factor from Gcal to GJ.

After determining the fuel consumption according to (1) and (3) and calculating the cost of the supplied heat energy, the information in the cards of the initial operators is filled in.

Results and discussion. Operation unit. The next element in the diagram is the operating block, with the help of which the equipment that produces the work, the product, etc., is described.

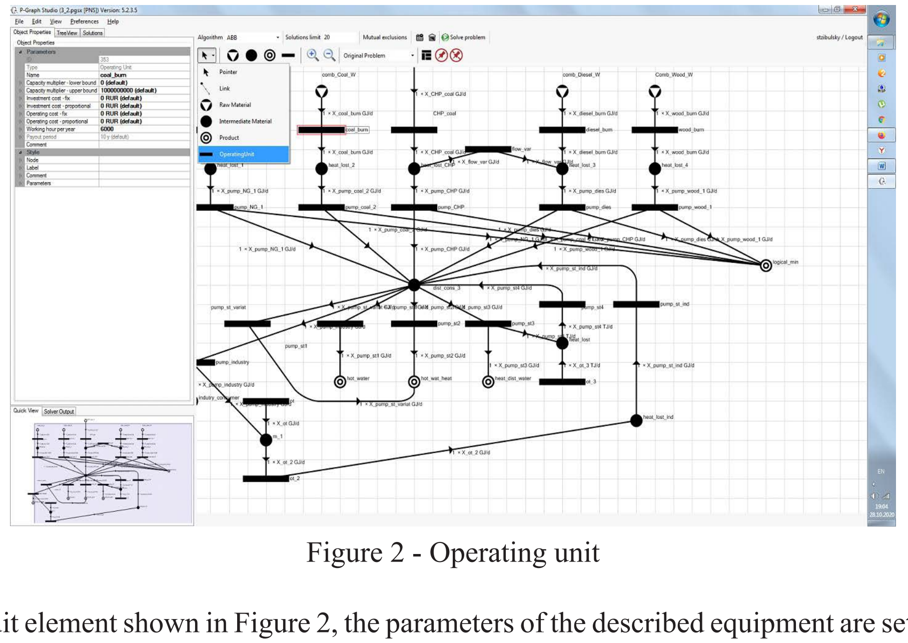


Figure 2 - Operating unit

For the circuit element shown in Figure 2, the parameters of the described equipment are set, such as: name (Name), lower and upper boundaries for resource consumption through this element (Capacity multiplier - lower and upper bound), investment costs (Investment cost fix), investment costs per consumer (Investment cost proportional), the number of hours of work per year of equipment (Working hour peryear), Link. This element of the diagram is used to link the operational unit (Operation unit with products (Raw Material, Intermediate Material, Product). At the entrance and exit from the operational unit, a certain conversion factor can be set (Figure 3).

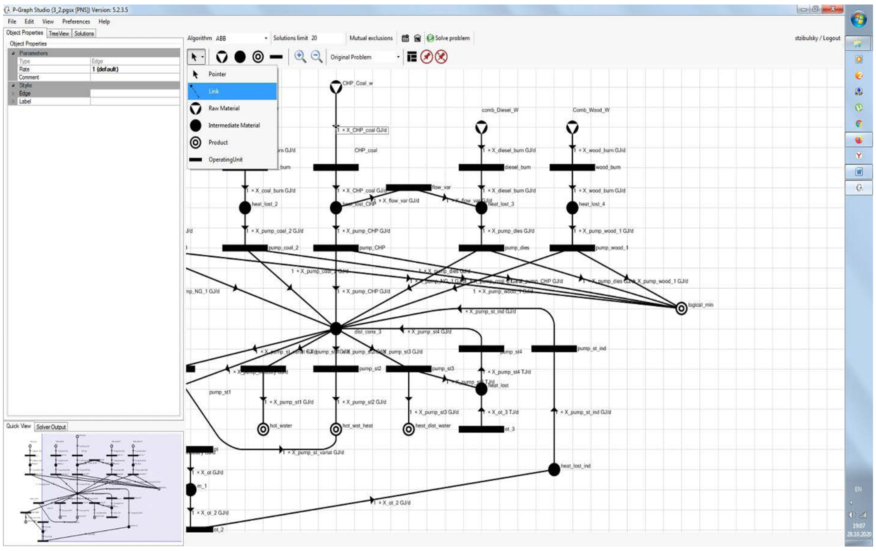


Figure 3 - Connecting line

Thus, using operational blocks and intermediate products, you can transform one resource into another (or several), linking them to each other with conversion factors.

Intermediate Material.The intermediate product is used to describe the loss of resources, delivery to an intermediate consumer, connection of flows from operating units, description of the name of the product and its characteristics, etc. The parameters to be set are similar to those of the initial resource (Figure 4).

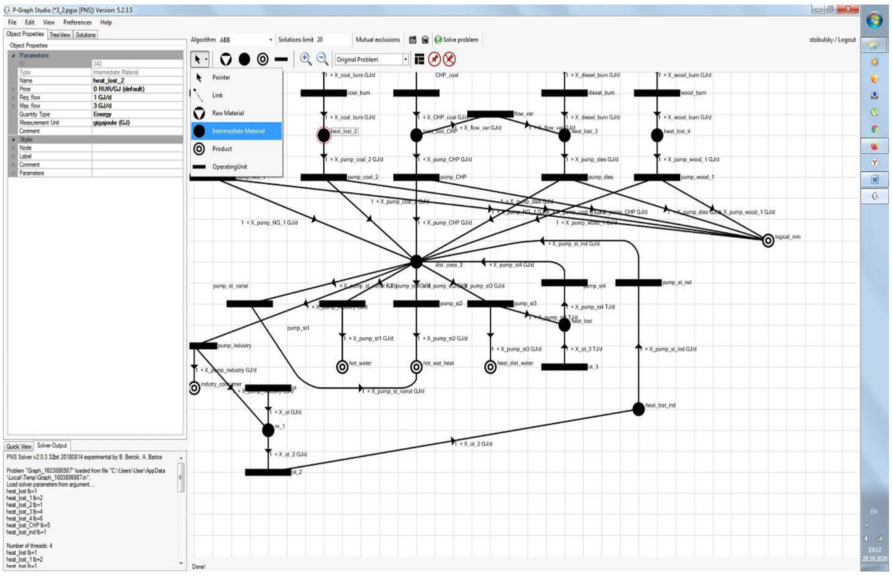


Figure 4 - Intermediate product

Product. The final product that goes to the target consumer, all parameters for this element are described in the same way as in the Drag and Drop Material and Intermediate Materialsections.

Scheme of conversion and return of network water to the collection collector. The part of the diagram presented in Figure 5 is necessary to describe the flows of energy and water for supply to consumers.

The "coll" collector receives flows of heat energy (Energy) from boiler houses and heat power centers. Further, from the common collector, the flows diverge through pumping distribution stations to the districts to consumers. The pumping station "pump_st3" receives 105 GJ/day of heat energy, in which there is a redistribution into two flows in a ratio of 2/3 to 1/3. The final consumer of heat energy "heat_dist_water" from "pump_st3" receives 70 GJ/day, which he consumes without returning the network water back to the sources. Heat energy 35 GJ/day in the form of heating water (with the possibility of returning to the network for further heating) is sent from "pump_st3" to the collector of water collection "cons_HE_HW". After the collector, the entire flow enters the secondary operator "HE_HW_2", which serves to distribute and collect direct and return network water from the consumer.

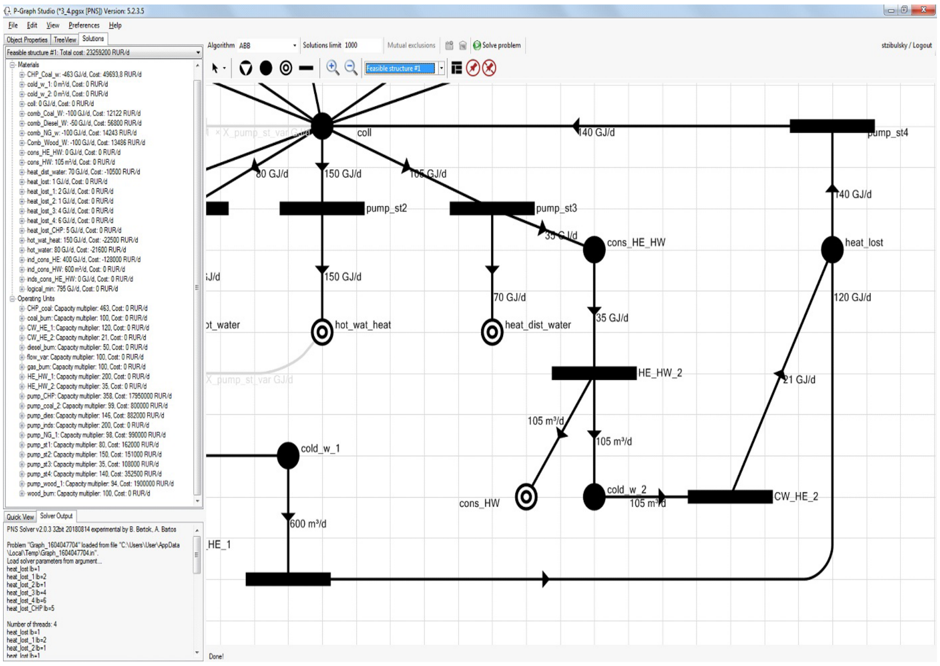


Figure 5 - A bunch of converting heat energy into network water and return of chilled water in the form of energy to the network.

At the same time, this operator serves to convert hot water from thermal energy, therefore, a multiplying coefficient 3 is installed on the line after it, which is calculated from the expression (4):

$$k_{HE\_HW} = Q_{TЭ}/G_{CB}\cdot c_{П}^{B}(t_{ПС} - t_{XB})=1\cdot 10^{3}/(1\cdot 4,1868\cdot(90 - 10)) = 3, \quad (4)$$

where: HE_HW index - shows the conversion from thermal energy to hot water (HeatEnergy → HeatWater); $Q_{TЭ}$ - thermal energy reduced to 1 GJ/day; G_{CB} - flow rate of network water, reduced to 1 m3/day, $t_{ПС}$ - temperature of the direct network, 90^{0}C; t_{XB} is the temperature of cold water taken from the well, 10^{0}C; $c_{П}^{B}$ is the specific isobaric heat capacity of water averaged for temperatures of 10 - 90^{0}C.

The end consumer receives heated water with a flow rate of 105 m3 / day with a direct network temperature of 90^{0}C. As noted earlier, the consumer's "cons_HW" heating system has a closed cycle, so the consumer returns water to the network with a return temperature of 60^{0}C. The water goes back to the operator unit "HE_HW_2" from which it goes to the element "cold_w2" with the same conversion factor 3, which is calculated by expression (4).

The element "cold_w2" is used to describe the transfer of heat energy from the heated water to the consumer's target, so, of course, its temperature dropped. For this, after this element "cold_w2" in front of the operating unit "CW_HE_2", a conversion factor of 5 is set, which shows the ratio of the heat to the flow rate of water contained in the return network water (5):

$$k_{CW\_HE} = Q_{TЭ}/G_{CB}\cdot c_{П}^{B}(t_{OC} - t_{XB})=1\cdot 10^{3}/(1\cdot 4,1868\cdot(60 - 10)) = 5, \quad (5)$$

where: index CW_HE - shows the conversion from thermal energy to hot water (ColdWater → HeatEnergy); t_{OC} - temperature of the return water supply, 60^{0}C.

Description of conditions for the total power of the system. Using the element "logical_min" and connecting lines coming out of the operating blocks, which characterize the operation of pumping stations, it is possible to set the lower and upper limits for the total capacity. In this case, the system can receive from 500 to 900 GJ / day (Figure 6).

With the help of the operating unit "CW_HE_2", the return network water with a temperature of 60^{0}C is converted into thermal energy: 105 m3/day comes to the operator's input, and 21 GJ/day at the output.

In the "heatlost" element, the flows of return network water are connected, and it also serves to describe possible heat losses during transportation to a boiler house or heat station. After the "heatlost" element, an operating unit "pump_st4" is installed to describe the costs of transporting the return network water to the stations.

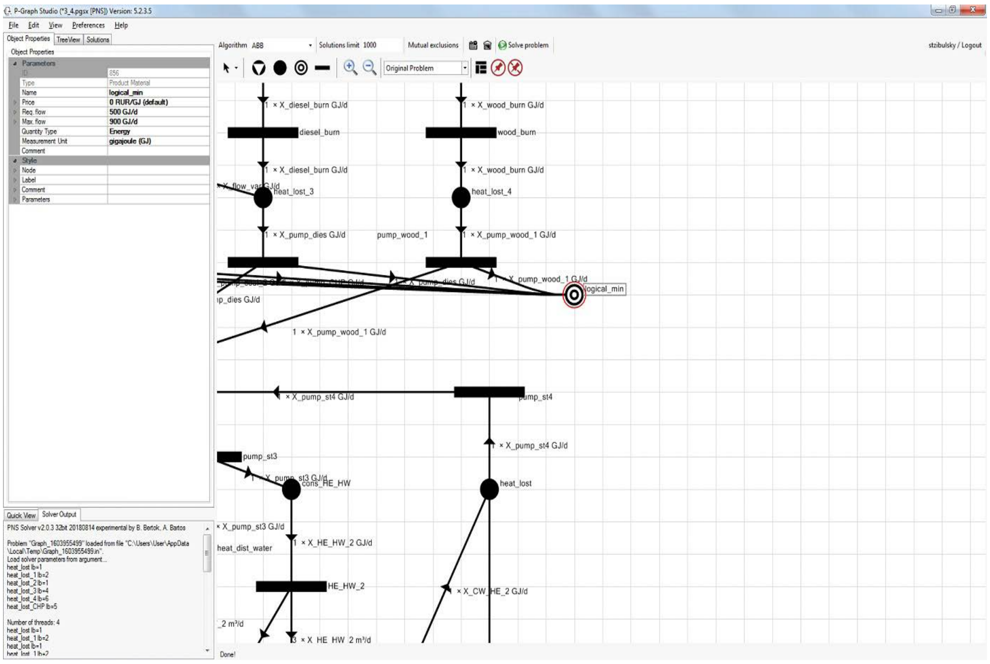


Figure 6 - Bundle to limit the required total load in the network

Conclusions. It should be noted that the “coll” element is used to collect and distribute heat energy flows. For this reason, after the operating unit “pump_st4”, the flow of heat energy of the return heating water is directed to the collector “coll”, and the remaining energy for heating the heating water comes from heat sources. Thus, the assessment of the efficiency of resources and the level of environmental impact is carried out on the basis of the analysis of the life cycle after determining the spatial boundaries and stages of the evolution of the system. An algorithm for controlling the heat and water supply of the region has been developed for the optimal combination of energy and water production / consumption facilities.

Acknowledgements. *The work was carried out within the framework of grant financing of scientific projects of the Republic of Kazakhstan for 2021-2023 with a period of implementation of 36 months on the topic AP09260365 “Application of integrated technologies to reduce environmental pollution and increase energy efficiency of industrial territorial complexes”.*

Information about the authors:

Z.I. Jamalova – PhD Doctoral Student M. Auezov South Kazakhstan University, Shymkent, zulya_d_85@mail.ru, https://orcid.org/0000-0002-1552-8321;

S.A. Boldyryev – Candidate of Chemical Sciences, Associate Professor at the National Research Tomsk Polytechnic University, Researcher at the Research School of Chemical and Biomedical Technologies, Tomsk, Russia. sboldyryev@tpu.ru, https://orcid.org/0000-0002-2866-3995;

B.M.Kaldybayeva – PhD, Associate Professor of M. Auezov South Kazakhstan University, Shymkent, Kazakhstan, kaldybaeva.b@mail.ru, https://orcid.org/0000-0002-1570-2107;

D.M. Kenzhebekov – PhD Doctoral Student M. Auezov South Kazakhstan University, Shymkent, Kazakhstan. doskhan_349@mail.ru, https://orcid.org/0000-0002-6367-5975.

REFERENCES

[1] Yaashikaa P.R. et al. (2019) A review on photochemical, biochemical and electrochemical transformation of CO2 into value-added products , J. CO2 Util.,33: 131–147.DOI:10.1016/J.JCOU.2019.05.017 (in Eng).

[2] GlobalEnergyReview (2020) [Electronic resource:www.iea.org/reports/global-energy-review(in Eng).

[3] NOAA National Centers for Environmental Information (2020). State of the Climate: Global Climate Report for Annual, from https://www.ncdc.noaa.gov/sotc/global/202013(in Eng).

[4] Bai Y. et al. (2019). How does urbanization affect residential CO2 emissions? An analysis on urban agglomerations of China, J. Clean. Prod. 209: 876–885.DOI: 10.1016/j.jclepro.2018.10.248.(in Eng).

[5] Yazdanie M., Densing M., Wokaun A. (2018) The nationwide characterization and modeling of local energy systems: Quantifying the role of decentralized generation and energy resources in future communities, Energy Policy. Elsevier, 118: 516–533.DOI: 10.1016/j.enpol.2018.02.045. (in Eng).

[6] Hansen É. et al. (2017) Water and wastewater minimization in a petrochemical industry through mathematical programming, J. Clean. Prod.,172:1814–1822.DOI: 10.1016/j.jclepro.2017.12.005. (in Eng).

[7] Wang J. et al. (2013) Thermodynamic analysis and optimization of an (organic Rankine cycle) ORC using low grade heat source, Energy, 49: 356–365. DOI: 10.1016/j.energy.2012.11.009. (in Eng).

[8] Bao H., Ma Z., Roskilly A.P. (2016) An optimised chemisorption cycle for power generation using low grade heat, Appl. Energy, 186: 251–261. DOI: 10.1016/j.apenergy.2016.06.080. (in Eng).

[9] Al-attab K.A., Zainal Z.A. (2017) Low grade waste heat recovery using diethyl ether thermo-fluid diaphragm engine, Appl. Therm. Eng., 127: 944–949. DOI: 10.1016/j.applthermaleng.2017.08.114. (in Eng).

[10] Wang T. et al. (2014) Waste heat recovery through plate heat exchanger based thermoelectric generator system, Appl. Energy, 136: 860–865.DOI: 10.1016/j.apenergy.2014.07.083.(in Eng).

[11] Pirmohamadi A., Ghazi M., Nikian M. (2019) Optimal design of cogeneration systems in total site using exergy approach, Energy, 166: 1291–1302.DOI: 10.1016/j.energy.2018.10.167. (in Eng).

[12] Sy C.L. et al. (2018) Synthesis of Cogeneration, Trigeneration, and Polygeneration Systems Using Target-Oriented Robust Optimization, Sustainable Energy Technology and Policies: A Transformational Journey, 1: P. 155–171.DOI: 10.1007/978-981-10-7188-1_7. (in Eng).

[13] Aviso K.B., Tan R.R. (2018) Fuzzy P-graph for optimal synthesis of cogeneration and trigeneration systems, Energy, 154: 258–268.DOI: 10.1016/j.energy.2018.04.127. (in Eng).

[14] Kryukov O.V., Serebryakov A.V. (2017) Energy efficient power supply systems of oil and gas pipelines electric Drives,Bulletin of South Ural state university. series: power engineering, 17(3): 102–110. DOI: 10.14529/power170312. (in Eng).

[15] Klemeš J., Dhole V.R., Raissi K., Perry S.J., Puigjaner L. (1997)Targeting and design methodology for reduction of fuel, power and CO2 on total sites, Applied Thermal Engineering,17(8):993–1003.DOI:10.1016/S1359-4311(96)00087-7. (in Eng).

[16] Cucek L., Mantelli V., Yong J.Y., Varbanov P.S., Klemeš J.J., Kravanja Z., (2015) A Procedure for the Retrofitting of Large-Scale Heat Exchanger Networks for Fixed and Flexible Designs applied to Existing Refinery Total Site, Chemical Engineering Transactions,45:109–114.doi.org/10.3303/CET1545019. (in Eng).

[17] Morandin M., Hackl R., Harvey S. (2014) Economic feasibility of district heating delivery from industrial excess heat: A case study of a Swedish petrochemical cluster, Energy, 65:209–220.DOI: 10.1016/j.energy.2013.11.064. (in Eng).

[18] Boldyryev S., Mikulčić H., Krajačić G., Duić N. (2016) Waste heat utilisation of Croatian cement industry accounting Total Site demands, Computer Aided Chemical Engineering,38:223–228.DOI: 10.1016/B978-0-444-63428-3.50375-1. (in Eng).

[19] Kaldybaeva B.M., Khusanov A.E., Dmitriev E.A., Sabyrkhanov D.S., Abilmagzhanov, A.Z.(2016) Modelling with simultaneous phase transfer chemisorption of hydrogen sulfide and carbon dioxide in the chemisorption apparatus/ News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences, 6(420): 178-184.(in Eng).

[20] Kaldybayeva B.M., Khussanov A.E., Abilmagzhanov A.Z., Boldyryev S.A. (2019) Experimental Justification of the Absorber selection for the Process of Simultaneous Chemisorption of Hydrogen Sulphide and Carbon Dioxide, Reports of the National Academy of Sciences of the Republic of Kazakhstan, 1(323): 40 -46.doi.org/10.32014/2019.2518-1483.5. (inEng).

[21] Belousov V.N., Smorodin S.N., Smirnova O.S. (2011) Fuel and gorenje theory. Fuel. [Toplivoiteoriyagoreniya. Toplivo.] -St. Petersburg: SPBGTURP. (inRuss.).

МАЗМҰНЫ

БИОТЕХНОЛОГИЯ

ФИЗИКА

СОДЕРЖАНИЕ

БИОТЕХНОЛОГИЯ

ФИЗИКА

CONTENTS

Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the originality detection service Cross Check http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will onh accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www:nauka-nanrk.kz

ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)

http://reports-science.kz/index.php/en/archive

Редакторы: *М.С. Ахметова, А. Ботанқызы, Д.С. Аленов, Р.Ж. Мрзабаева*
Верстка на компьютере *Г.Д. Жадырановой*

Подписано в печать 10.03.2022.
Формат 60х881/8. Бумага офсетная. Печать - ризограф.
7,5 п.л. Тираж 300. Заказ 1.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-19