Efficiency Assessment of Modern Technologies in Technical Re-Equipment of Production

Garina E.P., Garin A.P., Romanovskaya E.V., Andryashina N.S., Chelnokova E.A.

Abstract: ***In conditions of competitive environment and technological progress requirements for rational organization of enterprise activity and its technological development are tightened.The purpose of the study is to analyze a production technology and determine directions for increasing production efficiency in terms of economic and environmental efficiency.***

Object of study — Production Association of Polished Glass JSC AGC "Borsky Glass Factory".

Subject of the study — workshop organization in the enterprise management system.

Research methods — method of comparison and analogy, method of economic analysis.

The practical significance lies in the possibility of using research results to improve organization of the enterprise and its production sites.

These studies allow to draw conclusions about used technology of production on the example of a separate business unit, main technological parameters of processing raw materials, and output of products. Identified problems relate to the issues of economic efficiency of production of its environmental consequences, and directions of improvement are aimed at their solution.

Keywords: product production, technological process, process parameters, environmental performance

I. INTRODUCTION

The object of analysis is open joint-stock company "AGC Glass Company", which since 1997 is part of "Asahi Glass Company" - the Japanese world leader in the field of production of polished glass for the glass industry and forms for automotive glass. Technical and industrial indicators are determined by selected priorities in production (table).

Table 1 — Technical and economic indicators of production

Indicators	Years		Deviation	Growth rate, %	Increase rate,%
	2016	2017			
1. The volume of production in terms, (t.)	1980	2360	380	1,19%	19%
2. Revenue from sales, (million rubles)	7 341 695	8 352 833	1 011 138	1,14%	14%
3. Cost of production (millions rubles)	5 116 119	5 713 506	597,387	1,12%	12%
4. Gross profit, million rubles	2 225 576	2 639 327	413,751	1,18%	18%
5. Number of employees (people)	1378	1479	101	1,07%	7%
6. Average annual value of fixed assets (million rubles)	2 961 031 000	2 982 650 000	2 161 900	1,00%	0,7%
7. Average annual working capital balance (million rubles)	4 041 100	6 808 900	2 767 800	1,70%	70%

Table 2 — Production volumes, thousand tons

Organizational unit	Growth (decrease) of production			
	2016	2017	tons	% (to the volume of production in 2017)
Bushing Processing Workshop	34 928 000	48 450 000	100,740	7.2
Workshop Polished glass (PO)	79 450 000	95 145 000	125,000	2.9
Production as a whole	114 378 000	143 595 000	225,740	10.1

Indicators of production on commercial cost are presented in the table.

Table 3 — Production and marketing costs

Indicators	Years		Absolute deviation	Growth rate, %	Increase rate, %
	2016	2017			
1. Variable costs, total, million rubles	1279144	1648915	369771	1,28 %	28 %
Costs of raw materials	339634	458320	118686	1,34 %	34 %
Fuel, energy costs	329563	420580	91017	1,27 %	27 %

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***** Correspondence Author

Garina E.P. Minin Nizhny Novgorod State Pedagogical University e.p.garina@mail.ru

Garin A.P. Minin Nizhny Novgorod State Pedagogical University rp_nn@mail.ru

Romanovskaya E.V. Minin Nizhny Novgorod State Pedagogical University alenarom@list.ru

Andryashina N.S. Minin Nizhny Novgorod State Pedagogical University natali_andr@bk.ru

Chelnokova E.A. Minin Nizhny Novgorod State Pedagogical University chelnelena@gmail.com

Wages of production workers	503000	600311	97311	1,19 %	19 %
Social Security Deductions	106947	169704	62757	1,18 %	18 %
2. Fixed costs, total, million rubles	8112357.46	8240370.43	128012.97	1,05 %	05 %
general production expenditure,	933863	960068	26205	1,02 %	02 %
general expenditure,	642229	527021	-115208	0,82 %	82 %
Losses from defects	575184	353850	-221334	0,61 %	61 %
Commercial expenses	1254120	1283310	29190	1,02 %	2 %
3. Total cost, million rubles	4709660	5116120	406460	1,05%	5%
4. Costs per 1 ruble	1.46	1.43	-0.03	0,97%	3%

Indicators of production efficiency in terms of labor productivity are presented in the table.

Table 4 — Productivity indicators

Indicators	Years		Absolute deviation	Growth rate, %	Increase rate, %
	2026	2017			
1. Commodity products, total, million rubles	2017370	2066570	49 200	1,02 %	2 %
2. Payroll Fund, thousand rubles	778862	825973	47 111	1,06 %	6 %
3. Total number of employees, people.	1289	1487	198	1,15 %	15 %
4. Average annual output per 1 worker, thousand rubles /people	558.5	565.2	6.7	1,01 %	1 %
5. Average annual wage, rub.	1755	2275	520	1,29 %	29 %
6. Salary costs per unit of commercial products, rub.	0.68	1.43	0.75	2,10 %	10%
7. Average monthly output per 1 worker, thousand rubles /person	1397.3	1463.9	66.6	1,04 %	4%
8. Average monthly wage, rubles	27000	35000	8000	1,29 %	29 %

In the context of a policy implementation of localization of production, suppliers of glass are Guardian, Pilkington Glass, suppliers of components for the production of glass units: Artek, TBM Volga, Plast Trade, Tricon-NN. Competitors of JSC "AGC Bor Glass Works" on the regional market are: JSC "Salavat Glass", LLC "Pilkington Glass", "AGC Flat Glass", LLC "Guardian Glass" (table).

Table 5 — Competitors of JSC "AGC Bor Glass Works" in 2018

Company name	Description of competitor, note
1. JSC "Salavat Glass"	Company assortment: double-glazed windows, tempered glass, decorative glass, laminated glass, sheet glass. Production capacity - up to 1,100 tons of flat glass
2. Pilkington Glass LLC	The world leader in the production of sheet glass. Annually produced more than 240 thousand tons of glass used in the domestic market and supplied to the CIS countries
3. "AGC Flat Glass"	The company is part of Glaverbel, the European leader in the production of sheet glass. The company's products are used in construction projects, furniture and automotive industries
4. LLC "Guardian glass"	The American company Guardian Industries is the world leader in production of glass. Production capacity is up to 1100 tons per day. The main competence is SunGuard glass.

II. THEORETICAL AND METHODOLOGICAL APPROACHES

In the research process, methods of measurement, observation, systematization and classification of objects, process approaches to the organization of production and production technology of a product by an industry enterprise were used.

III. RESULTS OF THE STUDY

Due to significant volume of production, we will focus on activities of business units for the production of sheet glass. Production of sheet glass is an independent structural subdivision of "Polished glass". The structure diagram of polished glass is shown in the figure.

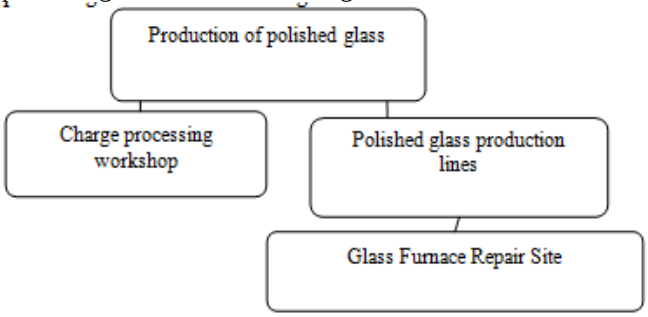

Figure 1 - Structure diagram of polished glass production

Glass production begins with the production of a charge (charge is a homogeneous physical mixture, pre-prepared and packaged according to the specified calculation, components). In production, there is an automated control system for the technological process of a charge preparation (ASUTP PSh). The table presents characteristics and technical requirements for raw materials and charge:

Table 6 — Characteristics and technical requirements for raw materials and charge

Name raw material	Brand, sort	ND Designation
1 Quartz Sand	Brand VS-050-1	GOST 22551
2 Field spar	Brand PSHC-0,50-21	TU 5726-036-00193861
3 Dolomite dry milled	Brand DM-19-0,20	TU 5743-001-57187975
4 Milled limestone	Brand IM 0,1-1,0	TU 5716-001-37479474
5 Soda ash technical	Brand A: Sort 1	GOST 5100
6 Sodium sulphuric acid technical	Extra Class	TU 2141-084-56238216
7 Carbon material	Class 0,1-0,8	TU 1971-002-80759242

The main technological equipment for transportation and sift of raw materials and preparation for requirements (table).

Table 7 — Characteristics and requirements for equipment at the stages of a technological process

Name and characteristics of equipment at the stages of the process	Assignment	Quantity, pc.
1 Quartz sand processing line	Sand storage	3
1.1 Silo can	Sand sifting	2
1.2 Sitho-Burat CM 237M		
2 Dolomite processing line	Transfer of dolomite from reception bunkers to silo can.	3
2.1 Chamber Pump TA-23B	Dolomite Storage	1
2.2 Silo can		2
4.3. Precipitation chamber		
3 Limestone treatment line	Limestone storage	
3.1 Silo can	Transfer of limestone from the receiving hopper to the "can"	1
3.2. Chamber pump TA 23B	Reception-precipitation of limestone	4
4.3. Precipitation chamber		2
4 Soda Processing Line	Soda storage	1
4.1 Silo can	Pumping soda from silo can to precipitation chambers	2
4.2. Chamber pump	Soda deposition	2
4.3. Precipitation chamber	Soda sifting	2
4.4 Sitho-Burat		
5 Sodium sulfate line	Submission of sodium sulfate to the receiving hopper	1
5.1 Electric hoist		
6 Field spar processing line	Storage of feldspar	1
	Sift of feldspar	1
6.1 Silo can		
6.2 Sitho-Burat		
7 Coal processing line	Coal transfer	1
7.1. Rotary water ring pump	Coal reception	
7.2. Precipitation chamber		
8 Consumables for raw materials	Intermediate storage of raw materials	36
9 Drum feeder	Loading components into the dispenser hopper	21
10 Auger feeder	Unloading components from dispensers hoppers	21
11 Valve feeder (valve with electro-pneumatic drive)	Loading (unloading) components into the dispenser hopper	12
12 Dosing and mixing line of batch preparation for production of colorless glass sheet	Dosage of sand, feldspar, limestone, sulfate, coal, dolomite, soda	20
12.1 Electromechanical weight dispenser		

12.2 Assembly belt conveyor	Feeding of charge components	3
12.3 Mixer EIRICH	Mixing components	3

Figure 2 shows a diagram of the process operations.

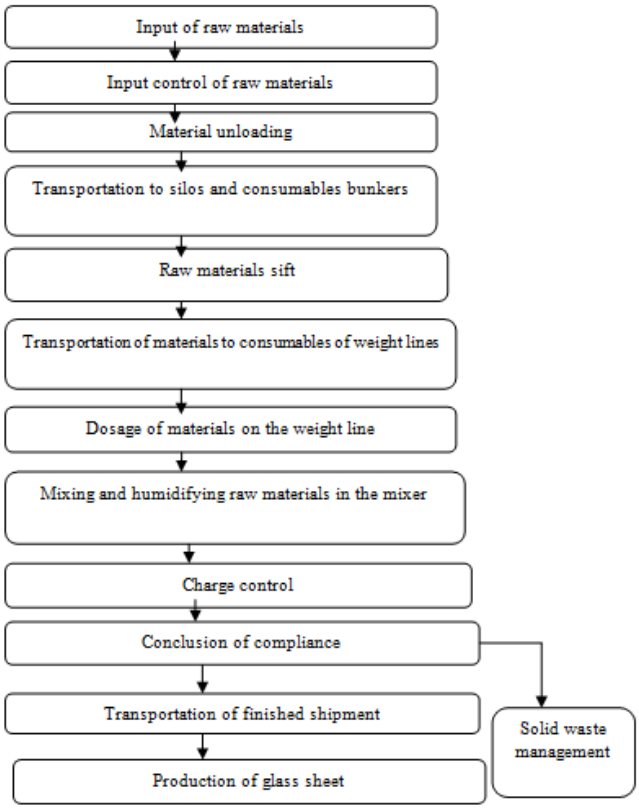

Figure 2 - Diagram of a technological process of preparing the mixture for colorless glass sheet

The order of workflow execution is shown in the table.

Table 8 — Process Order

Name of executed action	Execution of the operation (action)		
	Who	When (where)	Based on what documents is executed
1 Input control of raw materials	Laboratory in workshop and Laboratory of OOO "NAM - groups"	Upon receiving	IMM P (B) 412—1-1; control card of purchased products "Polished glass"
2 Unloading and transportation of raw materials to bunkers	Loaders of transport organization, consignment builders, crushers, CPU operator	After receiving the results of tests by the laboratory in the workshop and the permission of a shift master.	IR (B) 222/001-1 (WC); (records in the technological journal), register of carriages for unloading.
3 Sift of raw materials	Compilers of the charge, crushers - grinders	Continuously during the shift	IR (B) 222/001-6 (WC), real STP
4 Transportation of materials to consumables of weight lines	Charge compilers, CPU operator, crushers - grinders	As required	STP 001 (records in the technological journal, database ASUTP PSH)
5 Dosage of materials on the weight line	Charge compilers, CPU operator, crushers - grinders	Continuously during the shift	STP 001 (log entries)
6 Mixing and humidifying raw materials in the mixer	Charge compilers, CPU operator, crushers - grinders	Continuously during the shift	STP 001 (log entries)
7 Charge control	Laboratory in workshop	Periodically according to RI	M 015, M 016 (records in the log of the laboratory)
8 Decision on Compliance	Shift Master	After control of the finished batch by the laboratory	STP 001 (records in the log and database)

Allowable deviations from the given composition of the charge for glass sheet colorless are given in the table.

Table 9 — Allowable deviations from the given composition of the charge

Name of charge component	Allowable mass deviations from the specified composition, %, not more than
Sand plus feldspar	± 1,0
Soda	± 1,0
Sodium sulfate	± 1,0
Dolomite plus limestone	± 1,0
Moisture	± 0,5

If the charge parameters deviate from the given composition more than permissible, the work of the dosing and mixing line is stopped and the sample is re-analyzed, a decision is made on corrective actions.

The assessment shows that a technological process for charge preparation is one of the "bottlenecks" of modern domestic glass production, since it is associated with intensive dust emission. Dust formation occurs in the processes of grinding, classification, mixing of the components of the charge, their drying and transportation, which causes deterioration of the ecology of glass production. Modern solutions in this area try to exclude stratification and dusting in all technological processes of the composite shop by means of advanced methods of transportation and construction of high-performance equipment: mixers and dispensers. However, the need for measures to reduce dust levels during the disposal of waste materials and raw materials continues to exist. The figure shows the concentration of harmful substances in the air for 2018; the situation before improvements

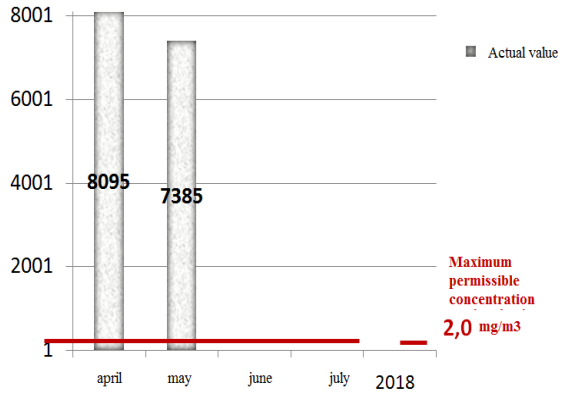

Figure 3 — Concentration of harmful substances in the air

According to the data, a high level of dust at the disposal of waste charge and raw materials is revealed and this is a big problem. For example, for the period April — May 2018 in a business unit the actual value was 8095 — 7385 mg/m3 with maximum permissible values of concentration not more than 2 mg/m3.

Dust can: reduce product quality; disable equipment; reduce illumination of premises; cause respiratory diseases; cause eye, skin, mucous and poisoning of the body.

At the level of the experimental site the cause-effect relationship can become:

- no leakproof conveyor for waste collection - it is necessary to select a conveyor with certain parameters and a specific type of g/p required.;
- discharge of "spills and clods» - it is necessary to develop and manufacture a container lid with flanges for connecting hoses. (Appendix);
- absence of hermetic hoses - it is necessary to choose the fabric and find supplier, to purchase rubberized hoses, then to carry out their installation;
- lack of lid fixation during container replacement - it is necessary to develop and manufacture hooks to fix the lid, as well as purchase two additional containers;
- lack of ventilation - it is necessary to change the operation algorithms of ventilation units to reduce dusting of materials on the transport line and improve the quality of the charge (fan stop time, cleaning time).

It is necessary to take measurements after installing a new spillage removal system, make changes to a truck driver and familiarize him with new requirements.

Tightness conveyor for waste collection, it is possible to pick up on certain criteria and type of enterprise storage. Purchase is not required. For the design and manufacture of container cover with flanges for connecting hoses (annex). It requires only labor, the necessary materials can be found in the plant's warehouse from available funds. Purchase is not required. For hermetic hoses, it is necessary to choose a fabric and find a supplier, to purchase rubberized hoses and to carry out their installation. It is necessary to purchase rubberized fabric and pay to supplier who will make hoses. To fix the lid of a container, it is necessary to design and manufacture hooks, as well as purchase two additional containers (V 8 cubic meters). Lack of ventilation, it is necessary to change the algorithms of ventilation units to reduce dust on the transport line and improve the quality (fan stop time, time cleaning). To solve this problem, money investment will not be necessary, only manpower is needed.

Solving issues will achieve results without significant economic costs (figure).

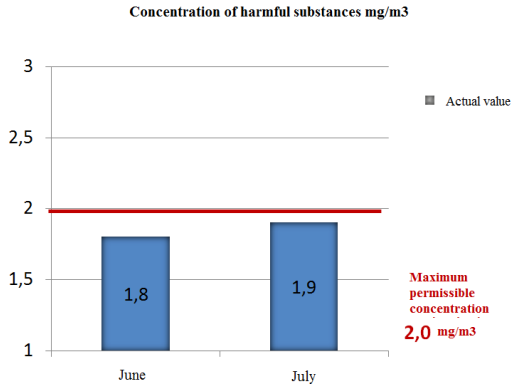

Figure 4 — Concentration of harmful substances

The estimated cost of acquiring new equipment for the dust removal project is presented in the table.

Table 10 — Cost estimates for new equipment

Name	Quantity	Price, rub.	Amount, rub.
Rubberized fabric	1	14 500	14 500
Container	2	27 500	55 000
Hooks	2	4000	8 000
Total:	-	-	77 500

The company has equipment and qualified personnel to carry out installation works, only additional funds are needed to attract a third-party organization for making hoses (5 000 RUB). The cost of new equipment is added to the cost of supplier payment. 77 500 thousand rubles + 5 000 thousand rubles = 80 000 thousand rubles.

Expected savings: 60 thousand rubles/year: Due to exclusion of payment to the contractor for cleaning spillages: 1 cleaning — 2660 rubles.; per year — 63840 rubles.

IV. CONCLUSION

The analysis of JSC AGC “Borsky Glass Plant” and obtained data allow to draw the following general conclusions about organization of the workshop in the enterprise management system. Glass manufacturing begins with production of a charge. Organization of activity management charge generating sets basic technological parameters of the process of acceptance, storage, processing and cooking the raw material batch for glass sheet colorless and heat absorbing glass sheet (green). When analyzing the activities of the enterprise’s shops, problems were identified and solutions for improving the business unit’s activity were given.

Proposals for improving activities in the charge development workshop take into account that industrial dust can reduce product quality; disable equipment; reduce the illumination of the premises; cause respiratory diseases; lead to damage to the eyes, skin, mucous membranes and poisoning. Measures to reduce dust in the workshop premises will not only protect people from injuries and risks but also in the future will help prevent damage to equipment.

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AUTHORS PROFILE

Garina Ekaterina Petrovna, Minin Nizhny Novgorod State Pedagogical University

Garin Alexander Petrovich, Minin Nizhny Novgorod State Pedagogical University

Romanovskaya Elena Vadimovna, Minin Nizhny Novgorod State Pedagogical University

Andryashina Natalia Sergeevna, Minin Nizhny Novgorod State Pedagogical University

Chelnokova Elena Alexandrovna, Minin Nizhny Novgorod State Pedagogical University