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**THE OPPORTUNITIES OF APPLYING REVERSE LOGISTICS
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Reverse logistics has been gaining more and more attention in recent years but its importance and its profitability is often overlooked. Let us take as an example one of the largest Belarussian industrial enterprises JSC Belaruskali which shows positive and cost-effective results of applying reverse logistics.

The amount of returned goods going backwards along the supply chain till the end point (customers) is usually much larger than people normally think. As an example, the sheer volume of returns generated in many companies ranges from 3% to 50% of total shipments across all industries. Many other surveys indicate that the real costs of the returns take up to 3% – 5% of total revenue [1].

Reverse logistics stands for all operations related to the reuse of products and materials. It is “the process of planning, implementing, and controlling the efficient cost effective flow of raw materials in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal. Remanufacturing and refurbishing activities also may be included in the definition of reverse logistics” [2]. The reverse logistics process includes the management and the sale of surplus as well as returned equipment and machines from the hardware leasing business. Normally, logistics deals with events that bring the product towards the customer. In the case of reverse logistics, the resource goes at least one step back in the supply chain. For instance, goods move from the customer to the distributor or to the manufacturer.

If the product is defective, the customer would return the product. The manufacturing firm would then have to organize shipping of the defective product, testing the product, dismantling, repairing, recycling or disposing the product. The product would travel in reverse through the supply chain network in order to retain any use from the defective product. The logistics for such matters is called reverse logistics.

The reverse logistics process can be broken into two general areas, depending on whether the reverse flow consists primarily of products, or primarily of packaging. For product returns, a high percentage is represented by customer returns. Overall customer returns are estimated to be approximately six percent across all retailers.

Reverse logistics covers a broad range of items and activities and can include:

- Movement of capital items and equipment to the next emergency response.
- Removal of containers and packaging from response area.
- Destruction of spoiled food commodities and out of date pharmaceuticals.
- Return of rejected goods to the suppliers.
- Movement of excess or over-supplied goods to other programs or organizations.

Although reverse logistics has been gaining more and more attention in recent years, a lot of companies have not fully realized its importance and what reverse logistics is. There have already been conducted many studies showing that reverse logistics has large potential to shippers' performance and customer relations, but unfortunately in reality the potential value of effective reverse logistics is often overlooked.

Effective reverse logistics is believed to result in direct benefits, including positive environmental impact by reducing amount of waste, including the improvement of customer satisfaction, decreased resource investment levels, and reductions in storage and distributional costs. Reverse logistics is becoming an area of competitive advantage.

Belarus like other countries of Independent States Commonwealth has still been unacquainted with the conception of reverse logistics. That is why it is so important to introduce scientific research in the field of reverse logistics where the waste of Belaruskali company is analyzed.

JSC Belaruskali is one of the world's biggest producers and exporters of potash fertilizers. The Company successfully exports its product to more than 90 countries.

Sylvite ores contain two kinds of salt – potassium chloride and sodium chloride. Industrial interest in potassium chloride is shown in the usage of it as a fertilizer, but its concentration in the ore is only 25–30%. The potash ores are the main raw materials used to produce potash and compound fertilizers and other chemicals. The potash ore generally consists of sylvite (KCl) halite (NaCl – the rock forming mineral) [3].

Potassium salt is removed by the concentrators, as a result, the remaining components of sylvinites become waste. While producing potassium chloride two types of waste are made: solid halite (salt), which is stored in the salt burrows, and the liquid sludge waste. Halite blade main component is sodium chloride. Most problematic aspect here is pickle, which is formed during storage of this waste: they can penetrate into the groundwater, and then come to the surface, thereby causing harm to the environment.

Economics

On average 1 ton of produced potash fertilizers contains 3-4 tons of waste. At full capacity production is about 20–25 mln tons of solid halite waste and 2.5 mln tons of liquid sludge accumulated during a year. The storage of the accumulated waste on the Earth's surface has led to the formation of salt dumps up to 100–120 m high and sludge storage tanks to accommodate the liquid clay-salt slurries. There are about 850 mln tons of waste including 112 mln tones of liquid sludge piled around Soligorsk with a total area of about 1,400 hectares. They are situated in the distance from 1 to 10 km from the city. As a result, the flat area has unique mountain landscapes and the brine lake. The growth of potash production at JSC “Belaruskali” contributes to the emergence of regional geo-ecological problems.

The main problem is that nothing can be made to recycle that huge dangerous waste. Thereby, there are few ways how to reduce the amount of industrial waste, how to recycle the existing piles of waste, how to gain profit and produce something for the society.

First of all, one needs to answer the questions:

1. What kind of products can one get from this waste?
2. Has one already had all the necessary facilities; or What kind of equipment does one need? How much will the expenses be?

When answering the first question, we can propose to use halite waste as de-icing means in road utilities or to lay halite waste in empty mines. For these activities we do not need any special equipment.

When speaking about liquid sludge – there are several ways to recycle it. For example, oil industry can use it as circulating fluid, wood products industry can apply it as an extender to decrease resin consumption. But undoubtedly the most perspective way is applying it in construction industry for producing foam blocks.

Supposing Belaruskali has already had one empty workshop. To make it the Company has to buy one automatic complex for producing foam blocks. The price for one facility is 30635 \$ [4]. The price includes the automatic complex itself, the technology of production and staff training. The productive capacity of this complex is 80 cubic meters per shift. Shift duration is 10 hours. The Company should organize two-shifts working day. The workshop is to work 5 days a week (10 shifts). In accordance with the requirements there should work only 1 person – an operator whose job is to maintain the exact operation of the machine. The average operator's salary should be not less than 500 \$.

To monitor progress according its reverse logistics plan, a company needs figures that measure the financial impact of waste on the firm. As a part of this process, the company should develop procedures for analyzing waste rates.

For a start, we determine the key parameters before making calculations (Table 1).

Table 1 – Main parameters of reverse logistics at JSC Belaruskali

Parameters	Units	Quantity
Total production	Mln t	10
The percentage of exports	%	92,5
Price per tone	\$	315
Quantity of complexes	piece	1
Price per automatic complex	\$	30 635
Life time	year	10
Productive capacity	cubic meters per shift	80
Shift duration	hour	10
Quantity of shifts per day	shift	2
Working days per week	day	5
Quantity of operators per shift	operator	1
Average salary of the operator	\$	500

Having stated what the major expenditures and performance indicators of Belaruskali are, we learn of what 1 cubic meter of foam blocks consists (Table 2) [5].

Table 2 – Contents and costs of 1 cubic meter of foam blocks

Ingredient	Quantity	Price per unit	Cost per 1 cub m
Cement	264 kg *	8 \$ (per 100 kg)	21 \$
Sand	210 kg **	-	-
Foamer	1 kg	2,5 \$	2,5 \$
Sludges	0,5 kg **	-	-

* Required quantity of cement is 310 kg. But the usage of liquid sludges allows to reduce the quantity of cement by 15 %.

*** Belaruskali has already got stocks of sand and required waste – sludges.*

Then we count up the total year's expenses and revenues from organizing reverse logistics (Table 3).

Table 3 – Total year's expenses and revenues from organizing reverse logistics at JSC Belaruskali

Indicator	Contents	Calculation	Result
Expenses (reverse logistics costs)	Cost of automatic complex, cement, foamer; operators' salary	$30\ 635 + (21+2,5)*80*2*5*48 + 500*2*12 =$ $30\ 635 + 914\ 400$	945 035 \$
Revenues	Selling price of foam blocks (on average 36,5 \$)	$80*2*5*48 * 36,5$	1 401 600 \$

Finally, we calculate quantitative assessment of implementing activities of reverse logistics (Table 4).

Table 4 – Calculation of quantitative assessment of reverse logistics at JSC Belaruskali

Indicator	Formula	Calculation	Result
Percentage of recycled material. Resources in waste	$\frac{TrCp}{CpC}$, <i>TrCp</i> – treatment capacity of material resources in physical terms; <i>CpC</i> – capacity of collected material resources.	$\frac{0,5 \cdot 80 \cdot 2 \cdot 5 \cdot 48}{2500500} = \frac{19200}{2500000}$	0,0077 = 0,77 %
Percentage of reverse logistics costs in total. Company's revenue	$\frac{RLC}{RevS}$, <i>RLC</i> – Company's reverse logistics costs; <i>RevS</i> – Company's revenues from production sales.	$\frac{945\ 035}{10\ mln \cdot 0,925 \cdot 315 + 1\ 401\ 600} = \frac{945\ 035}{2\ 915\ 151\ 600}$	0,0003 = 0,03%
Profit of reverse logistics costs (Effect)	$RevRL - yRLC$, <i>RevRL</i> – Company's revenues from reverse logistics; <i>yRLC</i> – Company's reverse logistics costs per year.	$1401600 - (914\ 400 + 30\ 635/10) =$ $= 1401600 - 917463,5$	484 136,5 \$
Profitability of reverse logistics costs (Efficiency)	$\frac{RLPt}{RLC} \cdot 100$, <i>RLPt</i> – Company's profit of reverse logistics costs.	$\frac{484136,5}{945035} \cdot 100$	51 %
Payback period	$\frac{RLC}{RLPt}$	$\frac{945035}{484136,5}$	1,95 ≈ 2 years

In accordance with the calculations shown above, we can conclude that organizing reverse logistics at JSC Belaruskali is quite a cost-effective and profitable activity (profitability is 51 % and 2 years' payback period). Moreover, such an activity like reverse logistics can help to decrease the level of waste made every year (reduction by 19.2 tons per year). It is not a very significant result but this is the production result of only one automatic complex. Buying several machines can increase the amount of waste recycled.

In order to imagine visually the productive capacity of one automatic complex let's see how many houses (spaced 200 sqm and required 80 cubic metres) might be built from Belaruskali's foam blocks: $80*2*5*48/80=480$ potential houses.

Such results can have positive impact on economics of our country. It concerns the government programme "Housing construction in 2016–2020" [6]. According to this Programme it will be provided no less than 40 % of individual houses.

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