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NATURAL AND RISKY LOSSES OF MATERIAL VALUES IN LOGISTIC FLOWS

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Abstract

The problem of rationing, natural losses accounting and risk losses of material resources as gas, liquid, fluid dust, electricity, heat in networks of distribution for individual use of mass consumers is discussed. It is shown that rationing of these types losses of material values unlike materials of other consistence during the transporting and distribution is represented by great difficulties. They are caused by specifics of giving them on complex technical systems: transport and distribution to mass users in the mode of continuous consumption; process organization complexity of places and time fixing of resources unauthorized selection from network for collective use. For the phenomenon of "imbalance" control in networks of resources distribution, the method of "frequent measurement of consumption volumes and determination of imbalance value" is considered. Implementation of this purpose is supposed to be provided with creation of different manufacturers "Automated Systems of Resources Commercial Accounting" (ASRCA) and also various sensors of operational reading and data transmission of instrument accounting in command center by consumption of resources. Systems are made by producers for gas metering, the electric power, and water and are guided by remote accounting of resources expenditure by consumers and operational calculation of a payment value for them.

Keywords: Standards, norms, distribution networks, natural, risk losses, imbalance.

1. Introduction

According to the process of material flow management and expenses definition in a logistics, not enough attention is paid to material flow losses. The reason for that installation on the logistic perfection of technologies and technology of operations realization declared in theoretical provisions of a logistics widespread editions for the mass reader. We suggested (economically rational) preparation of freights (packing, containerization and other) the material values for application to them high-quality methods of loading and unloading works, realization of the transport operations providing total savings for logistic expenses including preventing mass manifestation of natural losses when performing logistic operations is supposed.

2. Problem Statement

It is impossible to claim that natural and not natural (risk) losses of the material stream mass in a logistics are excluded completely. They do not take place only, and make significant volumes. Especially if we realize that the material flows make values mass which are affected to numerous logistic operations on all way, from the moment of origin and until arrival to the consumer.

The characteristic of the modern economy, logistic plurality of production, transport, warehouse links, predetermine both in production, and in the sphere of circulation, conditions for emergence and realization of losses risks and natural losses of raw materials, materials, semi-finished products, other types of the values forming the maintenance of the material processed streams at all stages of driving.

3. Research Questions

The branches of economy dealing with processes of transportation, storage, many overloads for material production are developed and apply guidance documents in which standards of admissible natural losses of the materials used in production are defined. For example, in the structural industry "RDS 82-2003 Norms of natural losses at storage and transportation of material resources in construction" (it is accepted and put into operation by the order of the State Committee for Construction of the Russian Federation of December 25, 2003 N 216) is used by (The State Committee for Construction of Russia, 2003). In RDS "natural losses" as an element of difficult and removable losses of products which are caused by physical and chemical properties are defined and arise in transit, loading – unloading and storage. According to this guidance document such types of losses as "shrinkage and aeration (a volatilization, destruction by frost, evaporation) of the moisture which is contained in products or a volatilization from it separate particles at temperature changes; leak at flowing through from one container in another, infiltration through a container or an absorption in it; races crumbs, a sprinkling and dispersion at loading and unloading". Storage of the material values is very expensive logistic operation.

4.   Purpose of the Study

The estimates of storage expenses which are carried out regularly show, that is from 25 to 50% of the total firms costs and arise according to wider list of the reasons provided in this document (The State Committee for Construction of Russia, 2003):

- losses of stocks because of evaporation, plunders, drying, spillage, radioactive decay, the fires, etc.;

- according to storage we may consider high-quality changes of material values in the form of deterioration in consumer properties because of irreversible processes in the stored product – decomposition, aging, rotting, change of appearance, etc.;

- the losses determined by obsolescence of material values, especially fashionable goods, personal computers, household electrical equipment, etc.;

- insurance, packaging, contingencies, taxes expenses, etc.

Idea of admissible natural losses standards in transit of the construction materials in different physical and chemical properties is given, for example:

a) standard norms decreased in transit cement in the covered cars and tanks cement trucks in bulk for different climatic zones. They are from 0.40% to 0.42% on weight, and in a transit container for the motor transport - from 0.25% to 0.28%;

b) norms of natural losses at storage in warehouses of oil products and fuel products in construction (reception, storage, issue) in kg/t, for different constructions of reservoirs: at storage in land steel reservoirs up to 400 m3 in different climatic zones - from 0.47 kg per ton of the accepted fuel up to 0.18 kg.;

c) when transporting a ceramic brick and stones, on railway transport (in transit packets) norms of decrease are ranging from 1.50% up to 1.65%, and automobile - from 2.00% up to 2.15% loading mass.

Apparently, natural losses on different construction types and power materials in cases of different options implementation of transportations and use of different transport types for different climatic zones – the natural phenomenon, have certain quantitative assessment, and are perceived as the phenomenon due, not subject to contest and claims.

Existence of these norms shows that in the commodity weight sent from the place of loading, and accepted by the receiver to use in production in point of unloading, there have to be discrepancies, but not exceeding the ordered norm and explained with natural losses of goods in the course of their bringing to the receiver.

Accounting of natural rated losses of materials is legalized, and it is not a subject to discuss. Expert Davydova (2019) demonstrates recognition of losses accounting: "Losses of material and production stocks at storage and transportation are equated to material expenses in case of their natural losses (within norms). Losses over norms can be included in structure of non-operating expenses in the absence of perpetrators (with documentary confirmation of the last)" (Deendarlianto et al., 2020).

5. Research Methods

Natural losses of material values in the course of logistic operations execution with material flows are in practice shown and made out in documentary different ways - in the construction and trade industries these losses join in material expenses.

At the same time decrease, over the norms, arisen for the reasons of plunder or violation of execution production requirements and logistic operations form risk losses and becomes a subject of special trial: identifications of perpetrators or documentary confirmed lack. On valuable materials for increase in responsibility of carriers for safety of loads insurance of loads widely practices. All these measures should be carried out for the question solution of compensation order damage, in case of partial or full loss. Where and when there was a theft or other look loss of materials usually is established without effort. But, it quickly manages to be set not on all material flows, only for loads of a subject and material look, or prepared for transportation in the form of piece transport units.

Decrease of the material flows making group of powdered (fluidity) of the liquid, gas, and electronic flows relating, in essence, to flows of matter of the weak molecular connectivity called in logistics by liquid, gas and electronic consistencies deserves special attention (Salimenko, 2013).

All these types of materials are consumed by mass consumers; it is continuous also individual process. Users at the same time only perform elementary operations in the form of opening and closing of cranes, actuating of material resource selection switches from the general distribution networks. Calculations for their used volumes, are made periodically, on meter readings of individual or collective accounting, usually this procedure is performed once a month. At first sight, debugged order of collective use of the vital resources, in all these systems "gets on" with a problem not of a satisfactory solution of a problem of rationing and accurate accounting of losses of resources in networks of their distribution.

Material flows, a material branch-off group, by analogy with other types and groups of material flows in logistics, are followed by a set of types of risk losses and natural losses.

In their structure:

- natural losses in the carrying-out networks, in the course of transportation and distribution of resources;

 - losses in the accidents arising in the resource distributing networks;

- losses from the uncontrolled and not authorized selection of the resources consumption in networks organized by some part of consumers in the form of thieves' withdrawal of resources from networks of the general distribution - water, pipeline, heat-conducting, pipeline, conductive (Sher, 2016).

In distribution networks of these material resources discrepancy types in issue volumes with volumes of recognized receiving resources in consumption from the system of distribution, is called "imbalance in distribution networks". The population organizing supply with vital resources of the industry of economy, conduct many years work on reduction of "imbalance" in "norm". Like norms of material natural losses in the industry, in construction, in trade and in the industries of the providing consumers these resources developed the normalizing losses on operation and repair of network distribution manifolds (A technique for definition of standards of electrical energy losses during its transfer on electrical networks (Ministry of Energy of Russia, 2016; Kermanshachi, Rouhanizadeh, Cobanoglu, & Damnjanovic, 2020; The Ministry of Construction and Housing and Communal Services, 2014; Najafi, Peiravi, Anvari-

Moghaddam, & Guerrero, 2020; The Ministry of Energy of the Russian Federation, 2001; The State Committee for Construction of Russia, 2001). Natural and abnormal losses in a share of expenses on their production and distribution are rather notable volumes. The supplying organizations try to obtain compensation of these losses in the different ways, but more often with increasing rates for payment of the confirmed volumes received by resources consumers.

Losses of water, heat, the electric power of oil products, natural gas, in networks of distribution according to sources (Mikhaylov, 2008; Kommersant, 2019; The Ministry of Energy of the Russian Federation, 2001; Sher, 2016; Peshkov, 2016), strike with the scales. In different regions and different authors have different digits, but the amount of losses (see the table 01) significant, mainly because of not authorized selection. In such organization a crucial role is played by the hidden selection and consumption of these resources. The organization of such depriving from the system of their distribution it is trivial: big knowledge, professional skill and efforts are not required. It is carried out also simply, as well as at the organization of the authorized consumption. At the same time the organization of process of considered resource transportation is simpler, this resource is more available than subjects to the organization of not authorized consumption.

Table 01. Imbalance of losses by types of material and energy resources

Name of material resource	Imbalance volume (natural and risk losses), (%%)	Name of an energy resource	Imbalance volume (natural and risk losses), (%%)
water	20 - 40	heat	30 - 40
gas	10 - 30	electric power	30 - 60

Source: authors based on Mikhaylov (2008), Kommersant (2019), The Ministry of Energy of the Russian Federation (2001), Sher (2016), Peshkov (2016).

The mass form of distribution was taken by the phenomena: unauthorized, not lawful inserts in distribution pipelines for depriving from the system of resources and correct operation violation of resources expense metering devices. In the first, and in the second cases conditions for uncontrolled expenditure of resources and "turnings" of volumes of "imbalance" in networks are created.

It is so early to speak about effective application in identification of inserts places and not lawful resources draws in collective networks. It is impossible to determine automatically draw places, abnormal leak, or emission of controlled resources. They can react only indirectly to the possible draw points functioning in network. Transformation of such systems into indicator sensors of arrangement into networks of initiation "imbalance" points caused by not authorized resource leak development of software products (decision circuits and algorithms and target computer programs) which conducted logical data processing and fixed the coordinated work of metering devices at continuous scanning of metering devices indications of flows in network, or quickly revealed violations of the natural change of dynamic indication device corresponding to lack of misconduct of resource depriving in network caused by emergence of accidental splashes in places of unauthorized character selection.

6. Findings

The presentation logic of resources expense in distribution networks in general and on their separate sections can be presented by record: "time balance" (Q_{rb}) is equal to the released volume of resources (Q_{ot}),

reduced by the value of volume spent by consumers (Q_{pt}) and a natural operational gas leak in pipeline system (Q_{ek}):

$$Q_{rb} = Q_{ot} - Q_{pt} - Q_{ek}.$$

From here volumes of natural, background gas losses, assuming lack of risk losses (abnormal (Q_{av}) and not authorized consumption (Q_{ns})), will be presented by such analytical formula.

$$Q_{ek} = Q_{ot} - Q_{pt} - Q_{rb}.$$

But it is logical to present the amount of background losses by a formula of integrated accounting for gas outflow through a lot of leaks in the network pipelines, which can be conventionally replaced with one hole equivalent in capacity to the sum of throughputs of the leaky places of the natural resource leak:

$$S_e = \sum S_i.$$

Assuming this formula as a basis, in a general view the volume of resource leaks, will be registered as integral from function of dependence of moment volumes of gas expiration $f(S_e, t, p(t), T)$ from set of factors - the total section (S) of leaks in network; time of observation (t); pressure in a pipe, as function from time ($p(t)$): and substance temperatures in a pipe (T), gas density $\gamma(t)$. That is the volume of natural losses can be calculated on the basis of an integration formula on t in observation range – from t_n to t_k.

$$Q_{ek} = \int \left(S_e, t, p(t), T, \gamma(t) \right) dt. \text{ (1)}$$

For conducting calculation for this formula it should be experimentally during some time perform measurements of issue (Q_{ot}), consumption of gas (Q_{pt}). And on this basis calculate operational (natural) losses (Q_{ek}) during the experiment.

$$Q_{ek} = Q_{ot} - Q_{pt}.$$

Having equated these losses to integral (1) substituting all factor values from an experiment, having left (S_e) as unknown value, and having solved this equation, there is this unknown. At the known values of factors of $t, p(t), T, \gamma(t)$, Se describing parameters of gas (substance) in a pipe at their test measurements, further important components for identification of "balance times" are defined by calculations:

- the volume of its natural losses – (Q_{ek}) integration on formula (1);
- the volume of gas issue (Q_{ot}) on measurement device of gas flow;
- the volume of gas consumption (Q_{pt}) on measurement devices.

7. Conclusion

The volume of balance times at the expense of not authorized selection (Q_{rbn}) follows from formula

$$Q_{rbn} = Q_{ot} - Q_{pt} - Q_{rb}.$$

Purity of an experiment on detection of these characteristics can be provided at an initial stage of network's section operation. When neither inserts, nor intervention in work of measuring devices appeared. Having revealed the interested characteristic (section of operational leaks-Se) it is possible to determine

further rather precisely the volume of operational gas losses – Q_{ek}. So, and risk losses, the values "balance time" in the set network space will also determine coordinates of places with risk gas losses - ($Q_{av} + Q_{ns} = Q_{rb}$).

In our opinion, developing this approach, it is possible to solve a problem of automatic detection of places with risk gas losses, volumes of balance times, leaning on opportunities of technical means for operational monitoring of gas status in distribution networks and applying software for operational data processing.

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