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B&M Publishing
San Francisco, California, USA

B&M Publishing
Research and Publishing Center «Colloquium»

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Science editor: E. Murzina

Published by B&M Publishing.
San Francisco, California

ISBN-10:1-941655-38-6
ISBN-13:978-1-941655-38-2

DOI: 10.15350/L_26/7

SCRIPTED CONTROL OF TECHNOLOGICAL PROCESS OF THE SUGAR PRODACTION

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Abstract

There is formulated the problem of management of major technological processes of sugar production, from the perspective of optimization script of quality indicators, efficiency use of material and energy resources, and productivity. There is created scripts of control and represented an implementation of the A-script control technological complex of sugar refinery.

Keywords: scenario approach, object control, sugar production, script.

Technological processes of the sugar production are very complicated in terms of optimization of indicators of quality, costs and performance and which represent a set mainly of sequential operations. It is appropriate to apply the script approach for such complicated systems. This approach allows to articulate adequately the views of experts on the course of technological processes and to carry out a multivariate analysis of situational control systems and provides making optimal decisions in management under uncertainty and risk. Each script connects the parameters of the object with the change of external conditions [1].

The script – is a way to achieve the goals, taking into account factors influencing the environment in which the system is located. It is characterized by objectives, factors of the influence, operations, interoperable connections [2]. Operation as a step of a script is determined differently in the abstract (A) and in the structural (C) scripts. In the first case, the operation works with unstructured objects (not considered internal structure of the object), change the input objects into the output (internal of transformation method is not disclosed, that operation is treated as a "black box"). C script comes from the fact that defined internal structure of objects which are described by the set of properties attributes. The attributes take the values from some area. These values can be changed due to the using of defined rules. Operation of the C–script is a unit which contains objects with the same set of attributes, it is treated as a class, instances of which – are the objects who "live in a certain space" [3]. The script is characterized by such components: goal, factors of influence, interoperable connections.

C-script constitutes a detailed elaboration of A-script taking into account the evolution of the object in the performance of operations and the transfer of operations from one to the other. Each class of the C-script works independently. His interaction with the "outside world", i.e. with other classes and the environment consists in the making in the input queues of new objects and the removal from the output queues "wasted" objects.

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There is allocated factors for sugar production, which directly or indirect affect the modes and are represented in the table 1.

Table 1

The factors that influence the behavior

Denotation	Description
F1	The sugar content of beet
F2	The cossettes length
F3	The Swedish factor
F4	The content rejection of beet pulp
F5	The number of Silin
F6	The quality of feed water

Object flows in the A-script of diffusion process are represented in Table. 2.

Table 2

The main of object flows

Denotation	Description
R1	The consumption of beet
R2	The consumption of pulp-press water
R3	The feed water flow
R4	The steam consumption
R5	The consumption of beet pulp
R6	The consumption of damp pulp
R7	The consumption of pressed pulp
R8	The consumption of diffusion juice

We form graphical representation of the A – the script system (Figure 1).

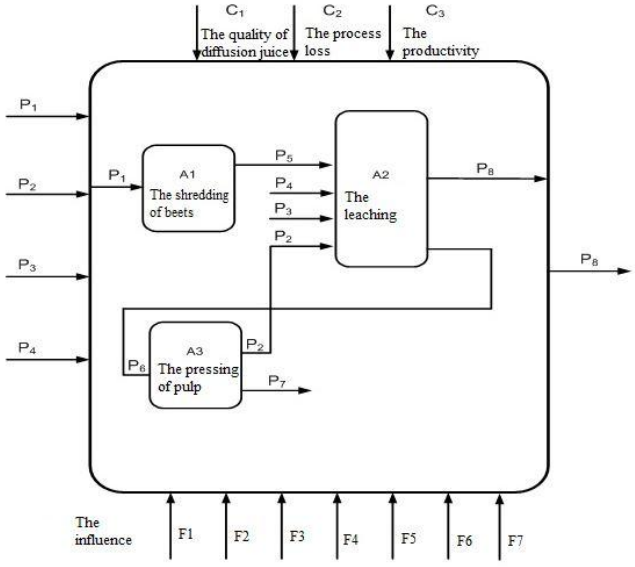

Fig. 1. A-script of the process of obtaining of diffusion juice

We distinguish two types of modeling behavior of system. Firstly, it is modeling functioning of the existing system, and secondly, the simulation of the system development. The scenario approach of modeling is effective for using before developing the system. This script should include the prediction of system development at various strategies, choosing (on the basis of prediction) best strategy, operations for implementing the chosen strategy.

A necessary prerequisite for building control script is the allocation of object attributes functioning (Table 3) and a text description of the life cycle of objects (Table 4).

Table 3

The attributes object C-the script

Class	Denotation attributes	Significance attribute
A1	a1.1	The number of Silin
	a1.2	The Swedish factor
	a1.3	The content rejection of beet pulp
	a1.4	The digestion
A2	a2.1	The quality of beet cossettes
	a2.2	The quality of feed water
	a2.3	The environment temperature
	a2.4	The pH juice
	a2.5	The duration diffusion
	a2.6	The size selection of diffusion juice
	a2.7	The content of solid
	a2.8	The pH of feed water
A3	a3.1	The downside of sugar

Table 4

The condition of life cycle

Class	Denotation attributes	Significance attribute
A1	S1.1	The shredding of beets
	S1.2	Improving the quality of beet pulp
	S1.3	Replacement of the blades of beet slicer
	S1.4	Improvement the behavior of beet slicer
A2	S2.1	The extraction
	S2.2	The supply of beet cossettes
	S2.3	The supply of sulfited water
	S2.4	The temperature depression of beet pulp
	S2.5	The temperature increment of beet pulp
	S2.6	The pH of depression
	S2.7	The increase suction of juice
	S2.8	The reduction of suction of juice
	S2.9	The correlation of beet cossettes – water
A3	S3.1	The sugar content reduction of pulp
	S3.2	The quality of pulp

One method of script analysis is a modeling using the apparatus of Petri nets. But the classic device of Petri nets is not free from flaws that limit the ability of solving practical problems [4]. The problem can be solved by imposing certain restrictions on the class of tasks, and it allows to select subclass with additional properties from the set of Petri nets [5].

We can call the system A controllable system of binary logic, if the system *A* has set of components $P = \{p_i\},\ i = \overline{1,n}$ with different characteristics;

each of component is in one of two states: active or inactive; on the set of components $P = \{p_i\},\ i = \overline{1,n}$ is defined a set of functions of transition from one state to another, each of which depends on a certain system events (lifecycle state control of the script). If among the functions of transition are present dependents on the interactive effects, the system A will be called interactively – controllable system with binary logic.

In forming the control script or script of the sugar production system and the name of a set the active components

$$S_i = \{p_i^{k1}, p_i^{k2}, ..., p_i^{kr}\} \subseteq P, \quad (1)$$

where, for $\forall_{pi}^{k} \in P_{ij}$, $p_i^k \in S_i$, if the state of p_i^k active the transition from state to state is made with a jump, by help of activating a different set of life conditions.

The process of functioning of such system is nondeterministic, as previously it is impossible to predict with certainty which of the sets can be activated at a certain time. This process can be formalized as a conceptual model, based on the theory of Petri nets. At the heart of this model lies the assertion that the logical structure of a certain system is limited Petri net $N = \{P, T, F, H, M_0\}$, where $P = \{p_i\},\ i = \overline{1,n}$ a set of positions; $T = \{t_j\},\ j = \overline{1,m}$ a set of transitions, in what connection $P \cap T = 0$; F_i and H – reflection of $F: P \to T$; $H: T \to P$, asked by the matrix of incidence $F: P \times T \to \{0,1\}$ and $H: P \times T \to \{0,1\}$, where $F(p, t)=1$, if transition t of incident positions p, $H(t, p)=1$, if the position p is incident the transition t; M_o, where $P \to \{0,1\}$ – the initial labeling or formatting.

Within this model of presentation of scripts the set of components of the system is represented as the set positions *P*; *T*- the set of all possible transitions from one state to another system [6, p. 362-364].

So we have identified factors that directly or indirectly affect the modes of sugar production. These factors are: the sugar content of beet, the cossettes length, the Swedish factor, the content rejection beet pulp, the number of Silin, the quality of feed water

Based on that data there is built the script of process control of the sugar production. The essence of this script is following: technological complex described by A-script based object flows considering all factors of influence and goals that must be achieved. This provides detection of links between technological elements that are difficult to follow, and their impact on the situation arising from the operation. Also there was made setting and solving the problem of network processes of optimization of the sugar production. In particular, proposed to solve problems of network optimization based on the Petri nets system, imposing certain restrictions on the class of tasks, which helps to choose a subclass with the necessary properties from a whole set of Petri nets.

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