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GENERALIZED NET-MODEL OF THE PROCESSES FOR THE PRODUCTION OF SODA ASH

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The general (in the lump) Generalized Net (GN) [1] – model is pointed out on Fig. 1. The model is type Intuitionistic Fuzzy Generalized Net – Model (IFGN2) and on the basis of that we will explain a technological generalized scheme for production of soda ash [2].

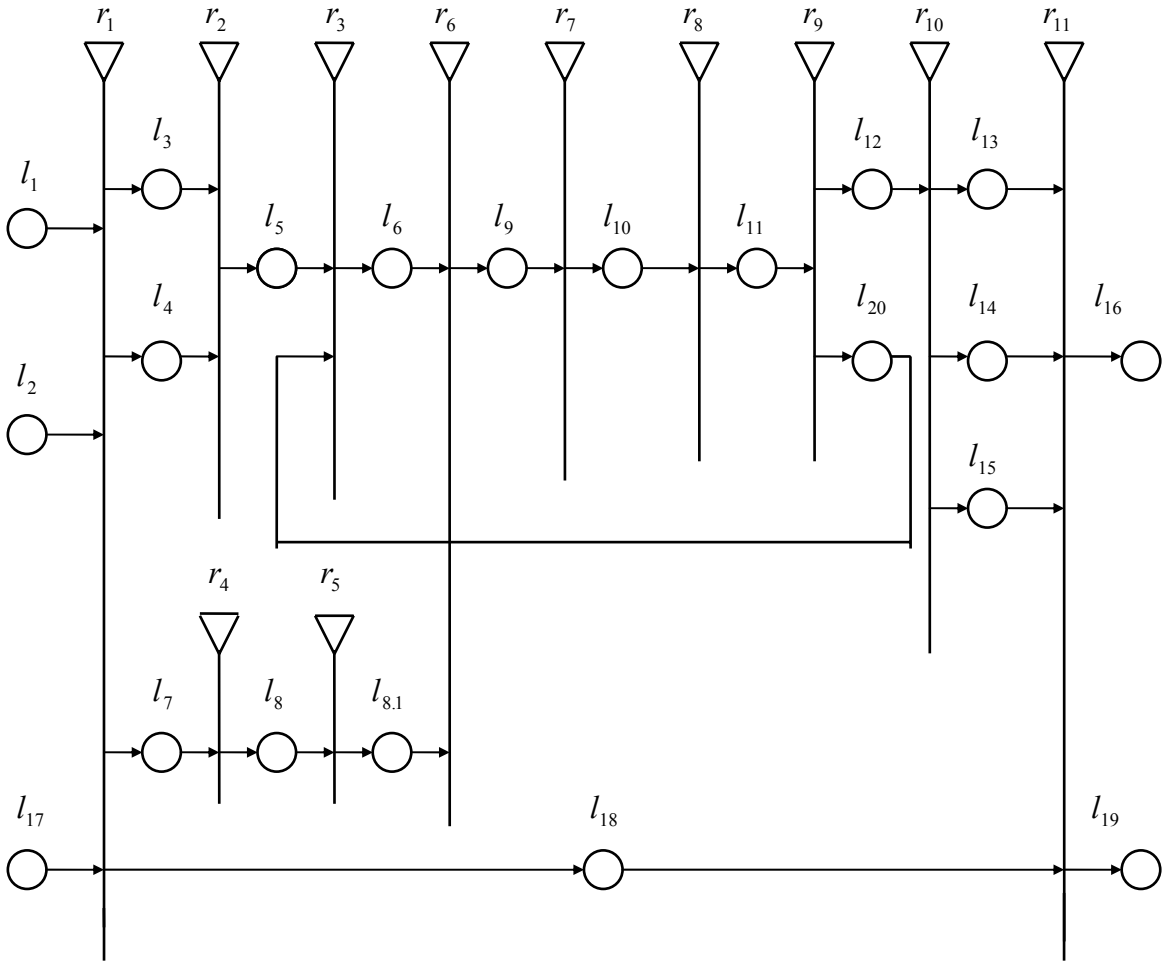

Fig. 1.

The signification of the place of the GN-Model (Fig.1) is the following, which corresponds to the tokens characteristics:

l_1 -basic raw materials
l_2 -subsidiary materials
l_3 -workshop for mining and sorting out limestone ($CaCO_3$)
l_4 -workshop for coking limestone
l_5 -baking of limestone in lime-kiln CaO and CO_2

l_6 -hydrogenation, slaking of CaO to lime-cream
l_7 -obtaining an aqueous solution of NaCl
l_8 -purifying of salt solution from admixtures (Ca and Mg)
$l_{8.1}$ -absorption, ammoniating of salt solution
l_9 -saturation of purified solution of NaCl with CO_2 (carbonization)
l_{10} -symbolizing the process of filtration (filtering of obtained suspension)
l_{11} -symbolizing the process of distillation
l_{12} -symbolizing the process of calcination
l_{13}, l_{14}, l_{15} -symbolizing the process of refrigeration, storing and packing
l_{16} -this position symbolize obtained finish product
l_{17} -symbolizing the receiving of orders for the end products
l_{18} -symbolizing the working of the orders
l_{19} -symbolizing the accounting of the orders (satisfied or not)
l_{20} -transport of waste distillate liquid for the process of hydration

The multitude of transitions A includes (Fig. 1) $A=\{Z_1, Z_2, Z_3, \ldots, Z_{11}\}$ where $Z_1, \ldots, Z_{11}$ are the transitions. Each transition contains six terms

$$Z = < L', L'', t_1, t_2, r, M >$$

For transition Z_1
$L' = \{l_1, l_2, l_{17}\}$ is an input place
$L'' = \{l_3, l_4, l_7, l_{18}\}$ is an output place

The indexed matrix *r* has the form:

$$r = \begin{array}{c|cccc} & l_3 & l_4 & l_7 & l_{18} \\ \hline l_1 & w_1 & w_2 & w_3 & w_4 \\ l_2 & w_1 & w_2 & w_3 & w_4 \\ l_{17} & w_4 & w_4 & w_4 & w_5 \end{array}$$

where:
w_1 - the raw material goes on mining and sorting out limestone
w_2 - the raw material goes on coking limestone
w_3 - the raw material goes on obtaining an aqueous solution of *NaCl*
w_4 - nuclei do not pass
w_5 - working of obtained

Indexed matrix (M) of the arcs will not be definite, because we have IFGN2 and the nuclei are quantity. The nuclei that may occur in the place are:

In place $l_1 = \{\alpha_1, \alpha_2\}$, which are respectively "NaCl" and "limestone".

In place $l_2 = \{\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5\}$, which are respectively "ammonia", "water", "water vapor", "fuel", "electric power".

For transition Z_2

$L' = \{l_3, l_4\}$ is an input place

$L'' = \{l_5\}$ is an output place

Indexed matrix, determining which nuclei may proceed across the transition has the form:

$r =$

	l_5
l_3	w_1
l_4	w_2

where:

w_1 -mined limestone go for baking in lime-kilns

w_2 -the coking limestone go in lime-kilns

For transition Z_3

$L' = \{l_5, l_{20}\}$ is an input place

$L'' = \{l_6\}$ is an output place

The indexed matrix *r* has the form:

$r =$

	l_6
l_5	w_1
l_{20}	w_2

where:

w_1 - raw material (CaO) goes for hydration (slake) to lime-cream.

w_2 - transported waste distillate liquid go for the process of hydration.

For transition Z_4

$L' = \{l_7\}$ is an input place

$L'' = \{l_8\}$ is an output place

The indexed matrix *r* has the form:

$r =$

	l_8
l_7	*True*

For transition Z_5
$L' = \{ l_8 \}$ is an input place
$L'' = \{ l_{8.1} \}$ is an output place

The indexed matrix *r* has the form:

$r =$

	$l_{8.1}$
l_8	*True*

For transition Z_6
$L' = \{ l_6 , l_{8.1} \}$is an input place
$L'' = \{ l_9 \}$is an output place

The indexed matrix has the form:

$r =$

	l_9
l_6	w_1
$l_{8.1}$	w_2

where:
w_1 - lime-cream go for the process of carbonization
w_2 - ammoniated salt solution for carbonization

For transition Z_7
$L' = \{ l_9 \}$ is an input place
$L'' = \{ l_{10} \}$ is an output place

The indexed matrix *r* has the form:

$r =$

	l_{10}
l_9	*True*

For transition Z_8
$L' = \{ l_{10} \}$is an input place
$L'' = \{ l_{11} \}$ is an output place

The indexed matrix *r* has the form:

$r =$

	l_{11}
l_{10}	*True*

For transition Z_9
$L' = \{ l_{11} \}$ is an input place
$L'' = \{ l_{12}, l_{20} \}$ is an output place

The indexed matrix r has the form

$$r = \begin{array}{c|cc} & l_{12} & l_{20} \\ \hline l_{11} & w_1 & w_2 \end{array}$$

where:
w_1 - obtained distillate go for calcination
w_2 - obtained waste distillate liquid transport for the process of hydration

For transition Z_{10}
$L' = \{ l_{12} \}$ is an input place
$L'' = \{ l_{13}, l_{14}, l_{15} \}$ is an output place

The indexed matrix r has the form

$$r = \begin{array}{c|ccc} & l_{13} & l_{14} & l_{15} \\ \hline l_{12} & w_1 & w_2 & w_3 \end{array}$$

where:
w_1 - obtained soda ash go for refrigeration
w_2 - obtained soda ash go in store
w_3 - the finished product go for packing

For transition Z_{11}
$L' = \{ l_{13}, l_{14}, l_{15}, l_{18} \}$ is an input place
$L'' = \{ l_{16}, l_{19} \}$ is an output place

The indexed matrix r has the form:

$$r = \begin{array}{c|cc} & l_{16} & l_{19} \\ \hline l_{13} & w_1 & w_2 \\ l_{14} & w_1 & w_2 \\ l_{15} & w_1 & w_2 \\ l_{18} & w_2 & w_3 \end{array}$$

where:
w_1 - raw material go to the line for a finished production
w_2 - nuclei do not pass
w_3 - the worked orders go for accounting (satisfied or not)

The signification of the position has been described right after Fig.1. GN-Model from Fig.1 is describing in following way:

$$E = << A,\ \pi_A,\ \pi_L, c, f >, < k,\ \pi_k >, < T,\ t^\circ,\ t^* >, < x,\ \Phi >>$$

The multitude of transitions (A) has been described above. All transitions have the same priority (π_A). The priority of the positions (π_L) is equal. The priority of positions l_{17}, l_{18}, l_{19}, is lower than the others.

As the net is IFGN2 and the nuclei are "quantity" flowing through the net, a part of them is lost during transportation, i.e. there exists a stage of indefiniteness. The priority of the nuclei (π_k) is equal. The net starts work at the fixed moment of time (T), defined on some kind of absolute scale of time (for example January 1st, 2000). There is an elementary step of time (t°), (for example during 24 hours), and duration of working (t^*) 365 days, whereupon there is a compulsory overhaul.

In place l_1 enter tokens with initial characteristic "type" and of the basic raw materials where the "type" can be "sodium chloride" *(NaCl*) and "calcium carbonate" ($CaCO_3$) –limestone.

In place l_2 enter tokens with initial characteristic "type" and the subsidiary materials where the "type" can be "ammonia", "water", "water vapor", "fuel", "electric power".

The characteristic functions (Φ) gives the end at the disposal quantity soda ash, which is produced.

The GN-Model from Fig.1 contains (like under-net) a component, that symbolize the receiving of orders for the end products (l_{17}), working of the orders (l_{18}) and accounting of the orders (l_{19}) – satisfied or not.

The nuclei in this sub-net are not "washed away" and they enter in the GN with initial characteristics connected with the firms that wish to buy a stock of products, their quantity and type, and receive as final characteristic definite information, connected with the implementation of the orders, as well, may include characteristic of the nuclei - duration, of realizing the request, etc.

The GN described on Fig.1 reflects the general existing connections between the different parts of the production of soda ash in the chemical works.

References

[1] Atanasov K. Generalized Nets, World Scientific, Singapore, New Jersey, London, 1991.
[2] Belchev I. Production of soda ash. Tehnika, Sofia, 1978 (in Bulgaria)