Research on the Mathematical Model for Developing the Oil Processing Company Environmental Strategies

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As an attempt to define and characterize the elements required for the ERE systems optimal driving programs (objective of reaching future) in this paper are presented the results made the connection ENE-ECO in order to optimize the operating mode of the oil processing companies installations, depending on environmental and energy indicators. Strong companies in the field, studies (and even started applying) modern methods based on mathematical modeling and neural networks for the correlations between energy indicators and the environment on the one hand, and processing parameters on the other. In order to structure such an optimization methods, the paper presents a mathematical model and calculation program for determining energy and environmental indicators, depending on processing parameters, which become tools of own conception, applicable to any production installation. The study of these models, enable to identify the specific conditions, that must be satisfied for that economic processes to friendly coexist for long term with the environment, namely, to have an minimal impact, meaning that the resulting residues from the economic activity of the organization to be as less harmful as possible for the environment.

Keywords: neural networks, mathematical model ,energy, environmental indicators

In the near future, the pollution prevention and control under the conditions of minimizing the material and energy loss [1-3] (which means basically to minimize the specific consumption of raw materials, fuel and power) should become subject for the optimal management of the macro system consisting of a number of ENE ECO, REC systems (ENERGY - ECOLOGY - RECYCLING) - operating on the principles of automatic control systems (RAS) located in direct interrelation.

Such issues are highly complex and are currently in effect of the proposal stage. It must however pass, in the preoccupations, even more so since in our country and abroad have already started studies and research on the possibilities of optimizing the correlations on the ENE-ECO; ECO-REC simple connections.

Such topics, from the restrictions of environmental protection and minimizing the material and energy specific consumption, can provide numerous data to optimize the functioning of chemical technological installations and the structure and the content of the chemical technology [4-6] .

Experimental part

In the context of the above, as a first attempt to define and characterize the elements required for drawing some programs for ERE systems optimal driving (objective of reaching in the future) in the following, will be presented the results made for the ENE-ECO connection in order to optimize the operating regime of the oil processing companies, based on environmental and energy indicators. Because of such reasons, strong companies in the field, studies (and even started applying) methods based on mathematical modeling and neural networks, of the correlations between energy and environmental indicators on the one hand and processing parameters on the other.

In order to structure such an optimization method in in the following was designed a mathematical model and an calculation program for determining energy and environmental indicators, depending on processing parameters, which become tools of own conception, applicable to any production installation.

The refining process for a petrochemical plant, can be characterized on the ENE-ECO connection with the help of the environmental and energy indicators.

To characterize a gaseous emitting pollutant sources, must be known the following environmental indicators:

- the average value c_m of the produced gaseous emissions concentration:
- the maximum value c_v of the concentration of these emissions;
- the total emissions *E*, basket plant evacuated in a certain time (hour, day, year), allocate by type of emissions.

The emission concentration can be expressed either volumetric (% or ppm) or mass (emission mg / Nm^3 flue gas), and the total amount of pollutants expressed in t/h or t/year.

The total amount of E emission it can be determined by the following methods:

- based on *hourly productivity* P_h (product tonns / h) of the generating noxious installation and the *average emission factor* f_e [kg emissions /product tonns]:

$$E_{zi} = P_h f_e 24 \quad [\text{kg/day}], \tag{1}$$

-depending on *the volumetric flue gas discharged flow from the basket zone*, D_{ga} (Nm^3 g.a/h), and the *medium mass concentration*, c_m (mg/Nm^3 g.a), for the analyzed emission type:

$$E_{zi} = D_{ga} c_m \frac{24}{10^6} \quad [\text{kg/day}], \tag{2}$$

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Results and discussions

To characterize in terms of energy an emitting pollutants petrochemical installation, that occur in manufacturing processes, can appeal to the following energy indicators:

- specific fuel consumption [Nm^3 comb./ product tonns];
- thermal efficiency [%].

Choosing the optimum operation of an gaseous emitting installation by burning fuel in a furnace, means choosing those operating points where environmental and energy indicators previously defined, have values which represents generating of the minimal amounts of pollutants, in the conditions of an efficient maximum energy (optimization through minimization).

Achieving the optimal compromise between these correlative components can only be based on an analysis to determine the dependency relations between the two types of indicators (environmental and energy) and combustion parameters (process transfer functions) and to find into an optimization mathematical model. Based on this model, are set driving programs for the process which one can choose the optimum operating points of the transformation installation, as the curves that can move (laws for process adjustment).

Based on theoretical general considerations from the specialty literature, were identified and systematized the combustion parameters of the physico-chemical characteristics of the fuel, which causes the level of generating emissions of NOx and SOx in an installation where there are combustion processes.

Thus, the total amount of NOx emissions and concentration (environmental indicators of the process) is determined by:

- the combustion parameters: combustion temperature, the oxygen concentration in the combustion zone, temperature and the fuel flow;
- fuel characteristics: calorific power; content of nitrogen. SOx emission level is determined by:
- the combustion parameters: the oxygen concentration in the combustion zone, temperature and the fuel flow;
- characteristics of the fuel: sulfur content.

CO and CO_2 emission level is determined in the case of a combustion plant by:

- combustion parameters: the ratio of the fuel and air flow (air excess Ü);
- fuel characteristics: calorific value and viscosity (for liquid fuels).

Energy indicators that quantify the energy efficiency of a combustion process (specific consumption and thermal efficiency) are in their turn influenced by a lot M_e of combustion parameters and characteristics of the used fuel:

- excess air;
- fuel flow;
- fuel viscosity;
- calorific power value of the fuel;
- fuel pressure.

If the we noted by M_m the crowd of combustion parameters and the physicochemical fuel fuel characteristics influencing the level of the environmental indicators, than then there is a crowd $M_{em} = M_e \cap M_m$.

In the figure 1 the set M_{em} (fuel combustion parameters and characteristics that influence both environmental indicators and those energetic) is input to the optimized mathematical model for the combustion process.

Previously it was shown that a specific method for determining the *discharged emission amount E* to the basket, in case of the combustion products, is the use of relationships between the environmental indicators of the process, on the one hand, and the combustion parameters and characteristics of the fuel, on the other side.

Next, we define the relations between energy and environmental indicators (output of the process) and the fuel combustion parameters and characteristics (input into the process, fig.1). These connection relations, representing the process transfer functions are:

Energo-ecological transfer function Kee (t) of the system on which it can adjust the combustion process.

K_{ee} function [mg contaminant/MJ_c] is defined as the ratio between the amount of pollutants discharged into the atmosphere and the thermal power plant. The ratio, can characterize more suggestive the behavior of an energy type of source (installation, were are taking place the transformation processes of the fuels) than the classical emission factor [contaminant kg /product tonns]:

$$K_{ee} = \frac{E_h}{P_t}, \qquad (3)$$

E_h represents the quantity of pollutants discharged to the basket [kg/h] and P is the installation flue thermal power [kW].

But,

$$P_t = D_c Q_{inf}, \qquad (4)$$

D_c is the fuel flow noted by c (kg/h for solid and liquid fuels or Nm^3/h for gaseous fuels), and Q_{mf} is the lower calorific powe [kJ/kg sau kJ/Nm^3c].

Taking into account the relations (1) and (4), the notation (3) can be written:

$$K_{ee} = \frac{E_h}{10^{-9}} D_c Q_{inf} = c \frac{D_{gs}}{10^{-9}} D_c Q_{inf} \ [mg/MJ], \qquad (5)$$

From the relations (5) can be observed that, if the time variation of E_h and D_c parameters is taken into account, the K_{ee} factor become a transfer function of the system, $K_{ee}(t)$:

$$K_{ee}(t) = \frac{E_h}{10^{-9}} D_c(t) Q_{inf}, \qquad (6)$$

$E_h(t)$ and $D_c(t)$, being time variable functions, are input respective output for the analyzed subsystem (fig. 2,).

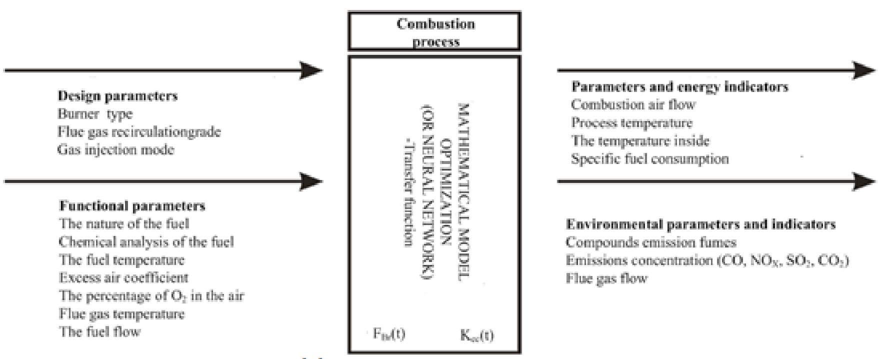

Fig.1. The mathematical model for the ENE-ECO connection

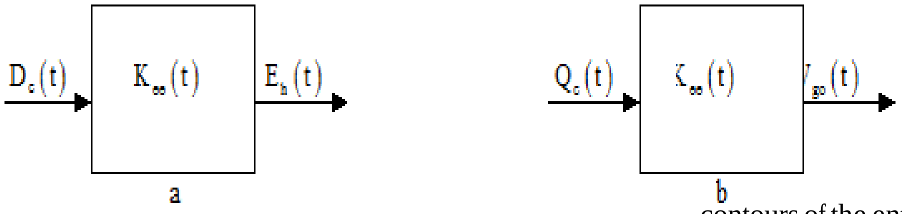

Fig.2. The mathematical model with transfer functions

Transfer function Fer(t) associated with the conversion factor

Another transfer function of the combustion process can be entered using a conversion factor of F_{Br}.

The conversion factor F_{Br} [Nm[3]ga/GJ], also called volume factor, is defined as the ratio between the volume of burnt gases V_{ga} and amount of heat the amount of the related fuel heat, introduced in the burner Q_c, which depends on his turn on the combustion time t:

$$Q_c = P_t t \; , \qquad (7)$$

$$F_{Br} = \frac{V_{ga}}{Q_c} \; , \qquad (8)$$

If we take into account the relations 5-8, we obtained

$$F_{Br} = \frac{K_{ee}}{Q_c} \; , \qquad (9)$$

The appropriate transfer function $F_{Br}(t)$ will be:

$$F_{Br}(t) = \frac{V_{ga}(t)}{Q_c(t)} \; , \qquad (10)$$

In the above relation $V_{ga}(t)$ and $Q_c(t)$ being the time variable functions, are inputs respective outputsfor the considered subsystem (fig. 2b).

Conclusions

From the engineering standpoint, for the assessing methods to strategies implementation, the polluting sources, emissions and immissions monitoring, becomes necessary.

On a global scale, the naturally environmental factor most polluted is the air (atmosphere) which cause in the analysis of the ERE correlations must necessarily take into account the dispersion of atmospheric emissions as a tool for optimization and monitoring them, as a technical absolutely necessary to pollution control. These considerations become even more substantiated as it is recognized that oil processing societies emanate significant quantities of pollutants (dust, smoke, soot and gases) of a great variety and harmfulness, that are airborne at great distances, contaminating considerable volumes of air, with negative impact on the health of the population and on the environment.

Thus, the dispersion is an effective technique to control air pollution, which aims to limit the maximum level of pollutant to the receiver. A network modernization can be used to satisfy different objectives and it is important to precisely defined its goals. Because the pollution is variable, both in time and space, it is necessary a large number of measuring sections, but due to their high cost, consensus must be reached. To get an accurate representation, the location of a single station, must be carefully chosen. Data processing and presentation of a report are also important. Also, to achieve a level of network performance, the tools must be carefully selected and verified.

On the resumption of the processes, the policies need to record specific recommendations, among others, by-products and own waste have to be recycled in their MCh contours of the enterprise subsystem. MCh subsystem can be characterized as open (non-isolated) computerized systems (cybernetic). In this context, the waste carrier of the technological information, in particular can be outputs for a system and inputs to another or to the same feed-back segment system. In the terms of the information, the waste reprezent a disturbance (noise) for the system. It is recognized that a certain amount of noise, should be to maintain the order, because they provide information about the state of the ecosystem, information that is not owned by the system components. This finding, may introduce the question if it is necessary and entropy effective the total decontamination?

The above statement, along with another already presented (thermodynamic total decontamination is not possible, because it can not be interrupted the exchange of the substance and energy between subsystem MCh and the environment) conclude that strategies and environmental policies must be designed that they do not propose *zero pollution*.

Implementation of the strategies and policies, monitoring of the results and resumption is clear arguments for the necessity of introducing the *quality system environment* which includes, in short, all the available scientific, environmental and economic informations which render correctly the quality and quantity of resources, capacities and functions in accordance with the standards, if partners and indicators have been standardized.

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