THE QUANTIFICATION OF ENERGY EFFECT OF LOSSES IN TRANSPORT AND DISTRIBUTION HEATING NETWORK

Mija Eduard Aurelian, *Ph. D. Ec. Head of Commercial Service at CET. Paroseni*
Iliaş Nicolae, *Prof. Eng. Ph. D. at University of Petrosani*
Preda Lucian, *eng. City Hall Petrila*

ABSTRACT: *The question arises quantify of total energy losses in the transport and distribution heating networks. Establishing total heating energy losses is achieved through a case study.*

KEY WORDS*: energy losses in transport and distribution heating network, energy losses in thermal point thermal balance.*

1. INTRODUCTIVE ASPECTS

For the companies that have systems and industrial plants burning thermal power in the patrimony, the termoenergetic balance sheet is used to check the conformity of results with the reference data and the establishment of measures to optimize power consumption.

The study has the character of a real termoenergetic balance sheet, taking into consideration the appropriate quantitative power flows.

As a analytical form/practice of expression of the principle of energy conservation for a certain period of time, in a specific contour, the termoenergetic balance sheet must confirm the assertion that, the energy released is composed of energy useful and related losses.

The work aim to determin, in 6 points of a thermal power system in the Jiu Valley, the following hourly quantities of heat : energy that entered the heat point ; useful energy ; useful energy - heating system, useful energy - warm water; lost energy, lost energy to the pipes and to the consumers, lost energy at the heat point. We built Sankey diagram, and the values obtained in the total loss of energy were compared with the national average.

Heating network in the Jiu Valley has been designed at the end of the 1970s on the basis of the technical economic calculations, which have been taken into account the whole system, and in particular of the need to ensure energy requirement in a centralized heating system for the users connect to this system as well as for future dwellings which were to be constructed in accordance with the urban development plan areas from that period.

These heating system network s have been installed in 1978 and delivery heat agent has started in the year 1981.

Heat supply of dwellings, economic operators and special institutions in the cities Jiu Valley (Petrosani, Vulcan, Vulcan) is carried out by a centralized system of power with hot water, having as source “Paroseni Power Plant”.

Paroseni Power Plant own the following capabilities for the production of heat energy and transport networks:
- Group energy No IV - 150MW and 150 Gcal/h;
- The boiler hot water - 103,2 Gcal/h (emergency source in the event of incidental stops and maintenance at the group of co-generation).

Hot water transfer of installations for the production of thermal power plant to the consumer shall be carried out by means of a pumping station, which operates in two steps of delivery, to send hot water through two transport network:

1. Bus 2 x Dn900 mm supplying consumers in cities Vulcan and Petrosani, bus designed for a flow rate of maximum 3600 t/h. The length of networks from Paroseni Power Plant up to furthest consumer in the territory in Petrosani town is approximately 18 kilometers. The district heating networks have diameters between Dn900 mm and Dn50 mm. The bus bills from Paroseni Power Plant to the hospital site up in Petrosani is located BGC (and distribution networks in the territory localities are located underground and BGC).
2. Bus 2 x Dn 500mm supplying consumers in Vulcan city, bus designed for a maximum flow rate 1200 t/h. The length of networks from Paroseni Power Plant up to the furthest away from the territory consumer Vulcan city is approximately. 7 kilometers. The district heating networks have diameters between Dn500 mm and Dn100 mm. Networks are located underground and BGC .

Petrosani City have 33 points connected to the centralized heating system; the system of heating of in Petrosani town has been sized for the original heat supply of 13,000 apartments, 7 schools, 4 high schools, many nurseries, kindergartens and pre-hospital settings, a hospital and other spaces locality with a thermal load required of 110 Gcal/hour.

As a result of layoffs in the mining sector and a reduction or closure of economic activities with activity dependent on mining has reduced the number consumers connect to SACET, both economic agents as well as to the population. At present the total apartments connected is in number of 2,406, to which add 33 private households, 11 public institutions and 169 companies.

Thermal power distribution shall be made through a number of 32 heating points, with an installed power of 78,18 per Gcal/hour from which for heating 68,15 per Gcal/hour and warm water On What 10,03Gcal/hour, the length of the distribution network is 54,804 m, with diameters ranging between 32 - 245 mm.

From a technical point of view, the situation of the power system with heat agent and domestic hot water shall be presented in the following way:
- all thermal power plants are equipped with next generation pumping systems ;
- from the point of view of the capabilities of the thermal power plants of the heat exchangers, the North can operate in good condition in the next five years, and the Aeroport area should be reevalueted in the forthcoming period.
- From the point of view of thermal networks percentage for the rehabilitation of them is approximately 40.8 %, the share of networks have been cleared being on the northern part of the city.

2. PROBLEM FORMULATION. CASE STUDY

In order to establish the quantitative relating energy, shall be made the following points: The measured termoenergetic parameters were: mass flow of heat agent delivered by CET PAROSENI; calorific output of heating fluid, heat agent temperatures on tour and return; the pressure heating fluid.

Flow rates and temperatures have been measured using ultrasonic flowmeter FLUXUS - ADM 6725, equipped with 2 sets of ultrasonic sensor for flow rates and 2 sets for temperatures.

Because between the ultrasonic flowmeter indications, with which they were carried out measurements, and the flow sensor from the heat point has been made sometimes positive or negative differences, in order to eliminate some errors, in the calculations were introduced average of that two measurements.

For the purpose of calculating thermal power supplied to the heating and hot water network, we proceed to the measurement of following parameters:

- mass flow of heat agent on tour and return of heating network switch ;
- calorific output of heat agent on tour and return of heating network switch ;
- mass flow of the heat agent shield on tour and return of primary circuit heat exchanger concerned hot water preparation;
- calorific output of the heat agent shield on tour and return of primary circuit heat exchanger concerned hot water preparation;
- heat agent mass flow on secondary circuit tour corresponding to the hot water preparation exchanger;
- heat agent calorific output secondary circuit tour corresponding to the hot water preparation exchanger;
- heat agent tour and return temperatures - primary circuit, secondary circuit;
- heat agent pressure - primary circuit, secondary circuit.

On the basis of measurements specified, were calculated:

- hourly calorific output entered into the heat point;
- hourly calorific output delivered to the heating network;
- hourly calorific output delivered to the hot water preparation plant;
- heat loss in heat point.

The calculation of the heat loss on the transport network and to the consumers has been carried out on the basis of the values heat charged to consumers (provided by the contracting authority) and heat values at the outlet of the heat shield.

Measured data and the results of the calculations are centralized in table 1.

The external environment and atmosphere characteristic parameters of the heat shield have been determined using the following devices:

-ULTRACUST - Termophil 4444- Recording Thermometer;
- LASCAR EL-USB-TC, K, J, temperature sensor and T-type and USB data logger;
- Pirometrul Assmann;
- Aneroid Barometer.

Environment heat losses by the exterior surfaces of the heat exchanger and pipes have been calculated on the basis of experimental determinations carried out with the following devices:

-Infra-red Digital thermometer in the type Fluke 576;
-Infra-red thermovision camera 2D THERMO HiTESTER 3460-50.

Therefore, in order to determine energy magnitudes entering the balance area, a part have been determined experimentally, another part it has been determined using a numbering calculation program, and a third part it was supplied by the beneficiary.

The results obtained are summary presented in table 1.

Table 1.Measuring Data

Current Number	Heat Point	Input energy in heat point		Useful energy heat plant		Useful energy hot water		Total useful energy		Lost energy on pipes and consumers		Lost energy in heat point		Total lost energy	
		Gcal/h	%	Gcal/h	%	Gcal/h	%	Gcal/h	%	Gcal/h	%	Gcal/h	%	Gcal/h	%
1	**PT-1**	**0.901**	100	**0.553**	61.429	**0**	**0**	**0.553**	61.429	**0.31**	**34.356**	0.038	4.215	**0.348**	38.571
2	**PT-2**	**0.067**	100	**0.064**	95.222	**0**	**0**	**0.064**	95.222	0.0022	**3.285**	0.001	1.493	0.0032	4.778
3	PT-3A	**0.217**	100	**0.185**	85.236	**0.02**	9.312	**0.205**	94.368	0.0092	**4.25**	0.003	1.382	**0.012**	5.632
4	**PT-4**	**0.188**	100	**0.067**	35.793	**0.019**	9.984	**0.086**	45.777	**0.098**	**52.145**	0.004	2.128	**0.102**	54.223
5	**PT-5**	**0.103**	100	**0.067**	64.593	**0**	**0**	**0.067**	64.593	**0.033**	**32.494**	0.003	2.913	**0.036**	35.407
6	**PT-6**	**0.154**	100	**0.067**	43.406	0.0056	3.668	**0.072**	47.074	**0.075**	**48.783**	0.0064	4.143	**0.082**	52.926

The summed values in Gcal/h and % have been previously planned in table 2 and show more suggestive in Sankey diagram from figure 1 :

Table 2. Hourly heat points real sheet

INPUT CONTOUR ENERGY			OUTPUT CONTOUR ENERGY		
Name	Gcal/h	%	Name	Gcal/h	%
Input energy in the heat point	1.63	100	Useful energy		
			Useful energy – heating system	1.003	61.53
			Useful energy – hot water	0.045	2.76
			Total useful energy	1.048	64.29
			Lost energy		
			Lost energy on pipes and consumers	0.527	32.33
			Lost energy in the heating point	0.055	3.38
			Total lost energy	0.582	35.71
TOTAL	1.63	100	TOTAL	1.63	100

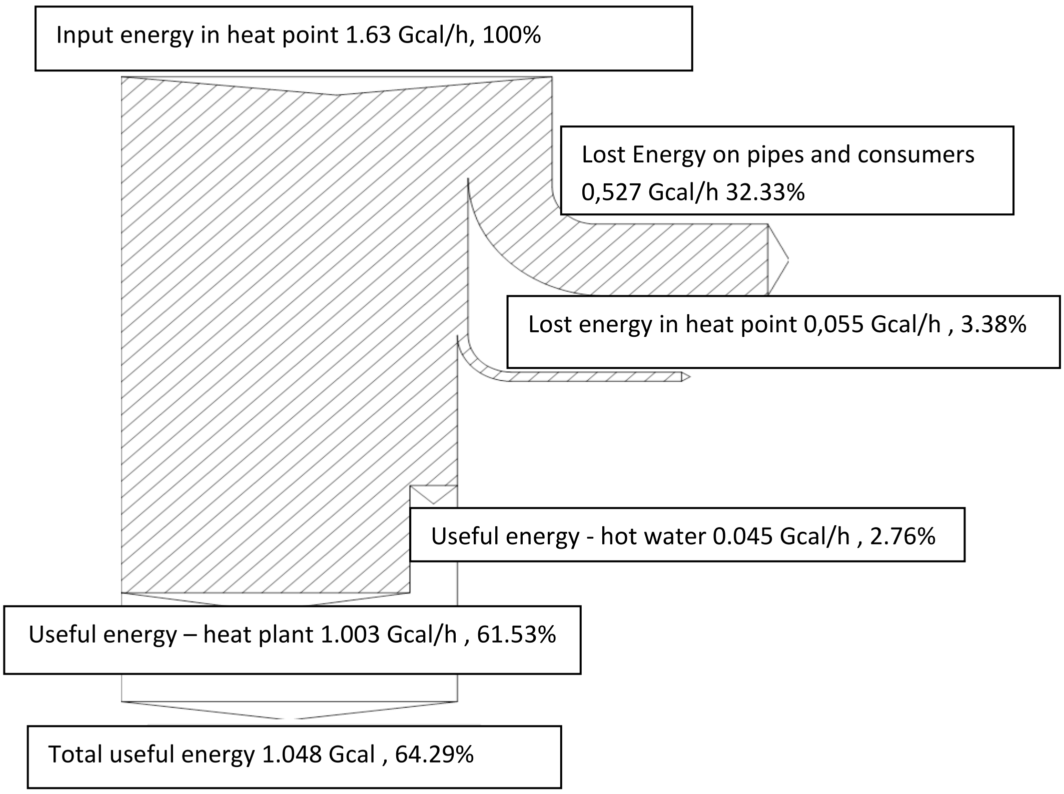

Fig. 1 Sankey diagram

3. CONCLUSION

The causes that have led some high values of losses are:
-disconnecting a large number of urban consumers from the thermal network;
-reduction of the number of economic operators by reducing or waiving of economic activities;
- reduce the flow of primary agent ;
-bad condition of thermal insulation, which on some portions is damaged or even missing ;
- high mass losses due large seniority pipes, with frequent occurrence of sharps;
Actions to increase energy efficiency:
-periodic inspection of heat losses by the agent and rapid intervention for reducing them,
-replacing or relocating of bus unions of the thermal power plants, on a new site so as to avoid intervention at unions which, at this moment, passes through private property ;
-restoring damaged thermal insulation.
For replacing and relocate pipes, will be developed conceptual designs on the types of pipe, the length and diameter pipes and types of insulation used.

Statistical documents relating to thermal power plants systems in Romania, show that total loss of thermal energy (energy lost to the pipes and to the consumers + energy lost in heat point) have an average value highlighted in the field 20 to 45 %. In the situation analyzed the value obtained is 35,71 %. As regards the total loss of thermal energy at the level of the heating points, they should be within the range 2-4. %. In the case of front study; the value is 3.38 %. It follows that to this category of losses the system analyzed fall to the upper limit of the mean values, without overcome them .

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