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# THE STEAM- SECONDARY SOURCE OF ENERGY IN METALLURGY

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## ABSTRACT

*The paper is focused on a study of how to use the steam from recovery boilers of LD converters to produce electricity in turbine generators and heat in a heat network.*

KEYWORDS: steam, converter gas, recovered energy

## 1. Introduction

The paper presents how to obtain and efficiently use the steam from recovery boilers of LD converters on the Steel Factory-Galati, Romania.

Each LD steel section contains three LD converters out of which two operates concomitantly. Each converter is fitted with steam recovery boilers. The thermal dynamic parameters of the steam are:

P=8-13 at
T=265 $^0$C
Flow rate=34t/h

The steam obtained from the recovery boilers in the LD factories was further used in the coke plant to heat the tar and radiators.

Now coke-plant is stopped so that excess steam is vented to the atmosphere.

The paper is focused on a study of how to use this steam, from boilers, to produce electricity in turbine generators and heat in a heat network.

## 2. Obtaining the converter gas

When preparing the steel in the oxygen converters, in the impact zone of the oxygen jet with the metal bath a local temperature of 3000 $^0$C is created. As a result of these high temperatures, 0.6 – 1.2% of the metal load is volatilized, as a reddish color smoke called converter gas.

Figure 1 illustrates the temperature dependence of the vapors pressure of Pb, Mn, Si, Fe, Ni.

The converter gas contains:

- metals vapors;
- gases: CO, $H_2$, $CO_2$;
- powder.

It is worth mentioning that there is quite an amount of furnace gas in CO, about 75% per charge and therefore its caloric power reaches 8500 kJ/Nm$^3$.

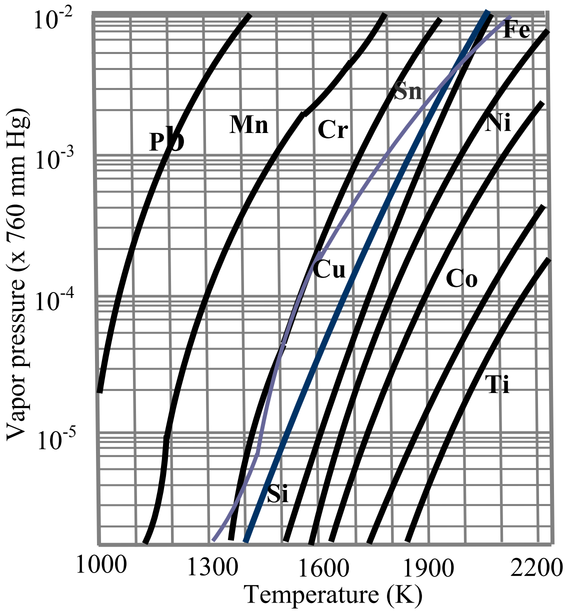


***Fig 1.*** *Temperature dependence of vapor pressure for some metals*

## 3. The heat recovered in the boilers from the LD converters section

At the converter outlet, the gas exhausted has a temperature of 1700 ºC.

In addition, in the annular space, between the converter outlet and hood, goals the air from the hall which helps burn CO in the converter gas.

This leads to an increase in temperature to 2750 ºC and an increase in the volume of burned gas about three times its volume before burning (Fig 2).

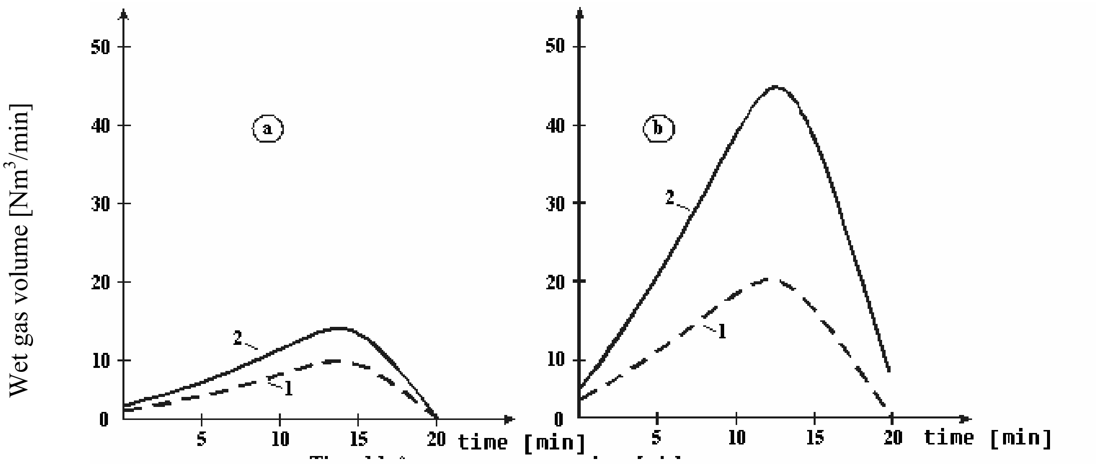


***Fig 2.** Variation of the converter gas volume*
*a. no gas in burnt in the hood: b. gas is burnt; 1.dry gas volume; 2.wet gas volume*

In the recovery boiler, fitted above the converter, the gas physical heat of 1700 ºC is recovered and, in the same time, the chemical heat of the fuel elements (CO and $H_2$). In the Figure 3 the scheme of the converter gas caption system is shown in the case of the gas burning in the radiation tower. The gases are cooled down to 1000 ºC in the radiation tower, and then are cooled down to 300 ºC in the converting part of the cooling tower.

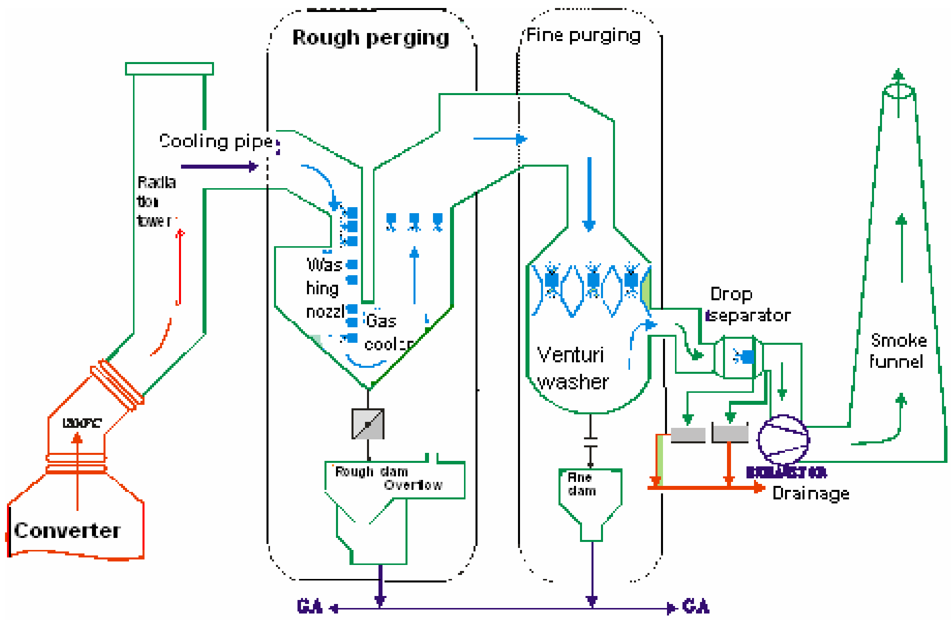


***Fig 3.** Scheme of the furnace gas capture system when the gas is burning in the radiator, where gases are cooled down to 1000 $^0$C , and then the converting part gases are cooled down to 300$^0$C*

## 4. Efficient use of the steam produced in the recovery boilers in LD plants

Because the process inside the LD converter is non stationary, the steam debit inside the recovery boiler is fluctuating. For this reason each LD converter plant has available a steam accumulator serving the three converters.

In figure 4 in shown the cooling system of the radiation tower, in the case of using the steam accumulator. In figure 5 is shown the functional scheme for a thermo-electrical plant, which uses steam from the recovery boilers of the siderurgical factory.

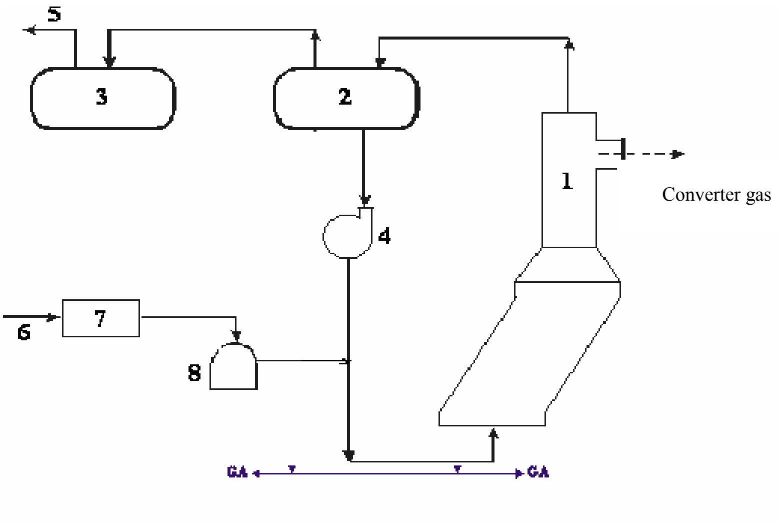


***Fig.4.*** *The hood cooling system when the steam accumulator is used:*
*1-hood; 2 – drum; 3 - steam accumulator; 4- recirculation pump, 5- steam for customers;*
*6- water supply; 7 - reservoir; 8 – boiler feed pump*

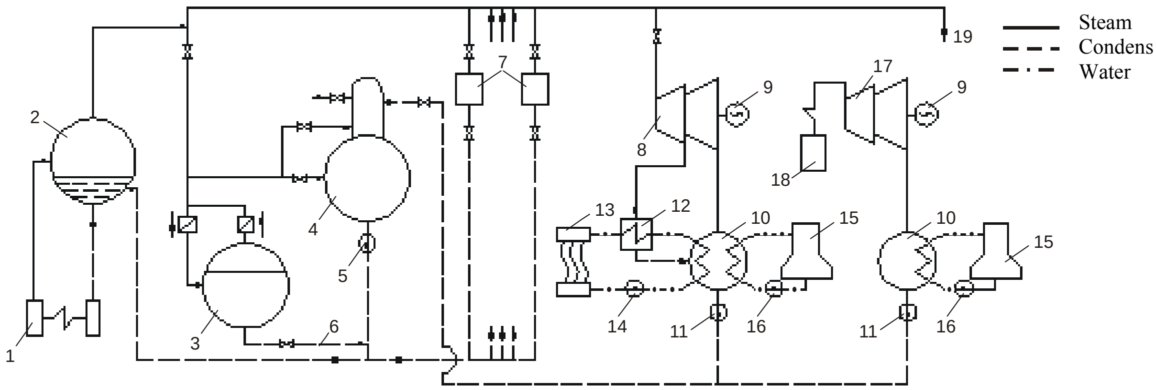


***Fig.5.*** *Scheme of a termo-electrical plant with steam from syderugical factory*
*1- recovery boilers; 2- drum, 3 - accumulator; 4- degassing; 5 – water pump,*
*6 – recovery condens;7 – steam boilers; 8,9 – turbogenerator, 10-condenser;*
*11 - condense pump, 12-water preheater; 13- radiators.*

## 5.Conclusions

The use of steam form recovery boilers of the LD steel plants in the production of electricity is very effective because the thermodynamic parameters of steam correspond, at the obtaining of a power of approx. 25 MW, to one turbo-generator. The investment required can be covered in about 3 years. The cost of electricity obtained by recovering the converter gas heat, in the recovery boilers, can be as low as 4 EURO/MWh, in comparison with the cost of 60 EURO/MWh in the national electric system.

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