ECOSHAFT® - the dawn of a new era in scrap melting

1945 the era of growth started and didn't seem to end. Everything was possible – everything was allowed as long as there was an economical benefit. Ecology was more an invective than an invitation.

2020 the era of growth has suddenly been stopped, by nature, by a man-made virus, or by accident. However, things have changed long before. Ecology is surrounding us since quite a time, has infiltrated our development, our engineering and that's good.

Already in 1980 engineers have started to think about saving energy, have developed a simple but effective scrap preheating process and ecologists have stopped them as they found cancerogenic substances in the off-gas at the chimney. Expensive additions had to be added to the simple scrap preheating making steel production more expensive than before.

Basically, when you look at your own house, you know you are heating it in winter time to be nice and well at home. The temperature inside is not very important, but you look very closely at the losses of your heating system. It's the same way the steel works manager looks at the losses of his production process. Here's what he sees:

The traditional furnaces are emitting a very big amount of energy into the atmosphere – up to 400 kWh/t. Reference is made to the publication of Pfeifer/Kirschen[1]. The shaft furnace does it with about 260 kWh/t, but careful, this figure does not include the reheating chamber as the reheating is not system

[1] Thermodynamic analysis of EAF energy efficiency, H. Pfeifer, M. Kirschen, 2002

relevant. The losses at the ECOSHAFT® are at about 170 kWh/t, or two third of the shaft furnace. The difference: The pollutants (paint, oil, grease, plastics, organic material) burn-off in the first container, and the post-combustion happens within the scrap pile so the scrap is actively heated up. The reheating burners to incinerate the produced compounds are incorporated in the preheating process.

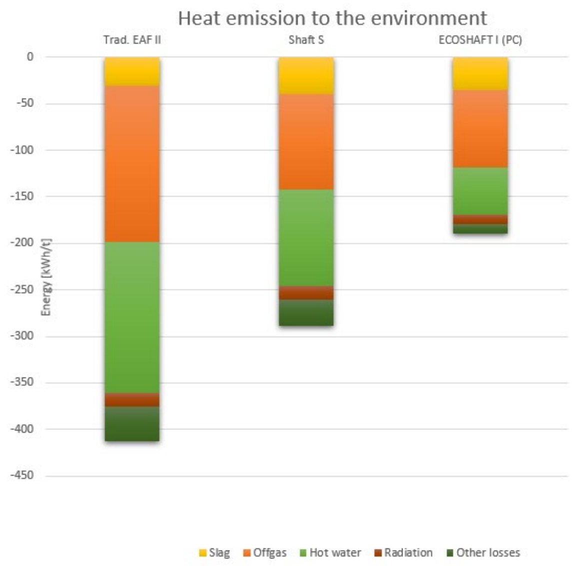

Figure 1 / Heat emissions (losses)without respecting the TA Luft

The 'heat emissions to the environment' chart (figure 1) shows the <u>apparent heat emissions</u> (external spectator), or losses (internal spectator) emitted at the atmosphere. The 'other losses' are unspecified losses mainly produced by the electric transformation and the electric resistance. Apparent, because the heat input and subsequent emission, generated at the reheating chamber and quench, is not included. But, this reheating chamber is definitely needed to handle the reformation of the pollutants emitted at the shaft configuration in order to fulfil the rules set by the environmental protection (see TA Luft).

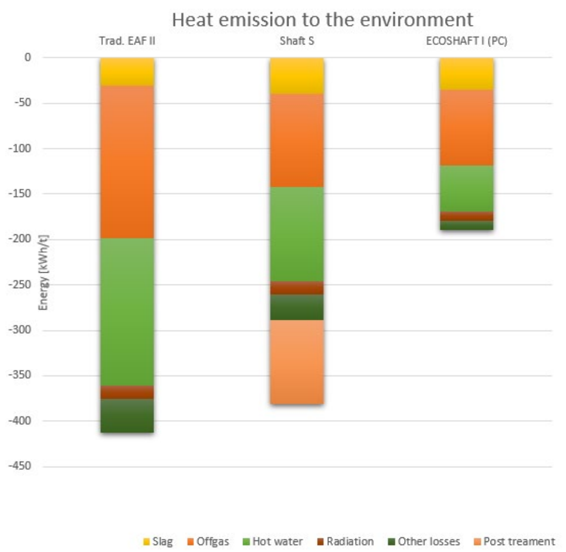

Figure 2 / Heat emissions to the environment respecting TA Luft

When respecting the TA Luft, the heat emissions to the environment (figure 2), of the shaft configuration are nearing the level of the traditional furnace design. However, there are some evolutions in the furnace design. The UHP (Ultra High Power) furnaces which are known for short tap-to-tap times and a high production rates are ranking at the top regarding the energy input and direct emissions to the environment. The following chart shows the comparison of one member of the UHP family with the shaft furnaces and with ECOSHAFT®.

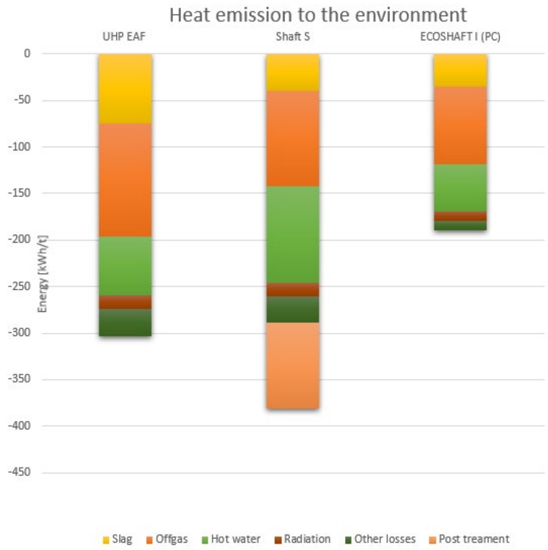

Figure 3 / UHP furnace vs Shaft and ECOSHAFT

The emission to the environment of the UHP furnace is considerably lower than the one of the shaft furnace due to the necessity of the post treatment of the off-gas.

Here some words about these **pollutants**. These pollutants, that are inherent to the scrap, get gaseous at a temperature of approx. 180°C and burn-off quite spontaneously, emitting an important amount of energy, also known as scrap-fire at scrap yards. This massive energy emission also happens at traditional furnaces then showing off as huge fire column. There it happens when charging the scrap from the basket into the furnace.

The gaseous hydrocarbons, chlorides and other elements are firing-off above the hot furnace (figure 4), and cool-down when mixing themselves with the surrounding air, where the reformatting of the compound happens. If they are sucked into the secondary dedusting system they will cool-down latest at the ducts leading to the mixing chamber, where the primary and secondary off-gas meet. Thus, these highly poisonous compounds are lying around the furnace and in the duct system of the secondary dedusting. As these compounds are reformatting themselves naturally, no reheating and subsequent quenching is required or would make sense. On traditional furnaces quenching towers may be required to limit the booster fan capacity by reducing total amount of primary dedusting air instead of mixing the off-gas with cool air.

Figure 4 / chemical reactions when charging scrap into an open furnace

Differently from that is the situation at the ECOSHAFT®. Here the cold scrap is loaded into a moderately warm container which doesn't heat up the scrap in a sudden burst. The chemical reactions are initiated by the hot off-gas and react in the scrap pile. The gaseous pollutants when flowing inside the preheating container are passing a flame threshold. The gaseous pollutants are heated-up and as they are remaining over the incineration temperature, there is enough time the complete incineration. So, they are definitely destroyed and unable to reformat. Thus, no reheating chamber, and no quench system is required.

The **post-combustion** is a semi continuous event which happens depending of the unreacted amount of CO in the off-gas. The reaction from CO to CO_2 starts as soon as there's enough free oxygen in the off-gas. The reaction speed is dependent of the off-gas temperature, the lower the temperature the slower the reaction speed. In traditional furnaces the post-combustion happens somewhere after the air inlet at the fourth hole, usually this is the spark arrester chamber or right after that. In shaft furnaces the post-combustion happens somewhere in the transfer duct to the reheating chamber, that's why in some steel plants a kind of support burner is installed to support and initiate the post-combustion at lower temperatures. At the ECOSHAFT® it's again different. An air flap allows to add the required amount of air or pure oxygen to initiate the post-combustion right before the warming container. As the off-gas speed slows down when entering the container area, there is enough time for the reaction within this area.

The two-chamber system of the ECOSHAFT® heralds a new era of energy saving installations: Efficient Scrap Preheating, Economic Ladle Furnaces, and Energy and Space Saving Vacuum Pumps with active over flow prevention.

ECOSHAFT® – uses the furnace off-gas energy to the maximum – a step toward a safe future – a step toward green steel recycling – for the sake of the environment and for the benefit of the steel plant.

Do you need more information? Don't hesitate to contact us, info@eco-eag.com www.eco-eag.com