PAST EXPERIENCE AND FUTURE TRENDS ON FUME CONTROL SYSTEM IN THE FERRO ALLOY INDUSTRY

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In the ferro-alloy industry, the main production tool is usually a 3 phase electric arc furnace. This furnace produces your commercial product, but also produces a lot of dust.

For the last 20 years, your industry has been extensively trying to solve the problem of stopping this pollution the most efficient way.

By efficient, I mean not only the lowest investment cost, but also the lowest running costs in maintenance and energy consumption.

Let us have a look at what has been done in this field up to now, and, based on this experience, what we think the producers who are going to invest in a pollution control system should do, and what those who already operate pollution control equipment, should do to improve their performance.

1/ RELATIONSHIP BETWEEN FURNACE HOODING AND DUST CONTROL SYSTEM

A/ OPEN FURNACES

The common arc furnace is of the open-type. It is found in most existing plants and is still used in new modern plants. The fumes are at a temperature of 150 to 300 Degree C, and can be filtered directly by a baghouse with fiberglassbags. For comparison purpose, we will say that such a system creates a fumes volume of "100", has an investment cost of "100", and an energy consumption of "100".

B/ SEMI-CLOSED FURNACES

There is a tendency, in new plants, to close more tightly the furnace , with rigid movable doors.
The gases then leave the furnace stack at 600 to 900 °C, and must be cooled, either with a tube type static cooler, or with a steam generator, (they could also be cooled by dilution with ambiant air, but we would be back to the previous case) Supposing that the cooled gases enter the filter at 300 deg C, the total gas volume would be between 30 to 50% of what an open type furnace would require.

In the case of the static cooler, the cost of the cooler (very heavy tubes) and the additionnal costs on the furnace design are detrimental to the savings made on the filter size. Therefore, the total investment cost is about 80 to 90% of the investment required for an open furnace. The static cooler creating a non-negligeable pressure drop, the total energy consumption savings are again jeopardized and the consumption should compare to 70 or 80% of the open type furnace.

The investment cost of energy recovery system like boilers and steam driven turbines is very high, but the energy recovery is sometimes spectacular : on a 50 MW FeSi furnace, the recovery can be up to 12 MW.

During a period of high energy costs, such an investment, with the help of heavy subsides from a "governmental department of energy savings" was justified. Today, it could still be technologically justified, but the economics of such a system are dubious.

C/ CLOSED FURNACES

Some type of products of the Ferro-alloy family are produced in totally closed furnaces (carbides). Most of the furnaces are using ventury scrubbers which are the least risky (explosion) devices.

It looks interesting to use dry filters (bag filters or ceramic filters), to obtain a gas clean enough to be burned.

The gas volumes to be filtered are very low compared to open type furnaces but contain a lot of CO. We have not built such bagfilters in the Ferro alloy industry although we have experience in filtering goses with high CO content in the carbon black industry. We know of a plant using sintered cartridge filter element, operating at 500 to 600 °C, but with very high pressure drops.

2/ WHAT TYPE OF FILTER SHOULD BE INSTALLED ON AN EXISTING FURNACE, OR ON A NEW FURNACE TO BE BUILT

The answer is found in the 20 years experience of users and filter manufacturers.

Wet scrubbers (except for the closed furnaces) have not been efficient in the capture of dust. They require a lot of energy (venturi = high Δ P). To our knowledge, no wet scrubber has been installed in the last 15 years on open or semi closed furnaces.

Electro static filters do not work, due to the physical characteristics of the dust.

We are then back to the bag filters.

Baghouses using polyester, nomex or glass have been used.

Pulse jet closed bag filters have also been installed in the ferro-alloy industry between 1976 and 1980, using polyester or nomex felts. I would call these 4 or 5 years "the jet age". The idea was to save initial investment costs by using so-called "high ratio filters". A net saving of 10 to 20% was indeed made on initial investments. However, high operating costs, short life of polyester or nomex bags and high pressure drop (=energy) have naturally shown the end of this "jet age". Today, nobody would seriously consider installing a jet filter on a ferro-alloy

furnace. More than 80% of all furnaces in the world are today fitted with pressure type open baghouses. It has now reached such a high reliability that a Ferro-alloy manufacturer can expect :

- A 100% operating time (ratio between furnace and filter operating time)
- A 0% bag consumption for 3 years or more
- A 99,8% filtration efficiency
- A power consumption of 3 to 5% of the furnace power.

However, not all baghouses can meet such figures.

A/ THE FILTERBAGS SHOULD BE IN FIBERGLASS

Nomex (R) requires an operating temperature below 200°C, too close to the sulfuric acid dew point. Nomex(R) bags have a life of 12 to 18 months, and cost twice the price of glass bags (which can operate at 295°C). We have 3 baghouses fitted with fiberglass bags operating on FeSi 75% furnaces where our clients have replaced 10 bags (out of 1 200 installed) over a period of 4 years.

A short remark, about a new media appearing on the market : it is a fiberglass fabric, coated with a PTFE porous membrane.The price of such a bag is 5 times the price of a normal glass bag, and the supplier has a monopoly. Its performance is claimed to accept 50 to 100% more gas flow than a normal glassbag at equal pressure drop.

It could be understood that somebody would be interested in testing these bags. It would be foolish to design a new filter solely based on these performances, saving only 15% on the original investment, just to find out, a few years later, that the bag life might be too short, or that the only company making these bags in the world has stopped supplying them.

B/ THE DUST HANDLING EQUIPMENT MUST BE RELIABLE

Many mechanical conveyors have been used, but the low pressure, large volume,cyclone type,pneumatical conveyor seems to be the cheapest and most reliable system used today.

3/ TYPICAL COSTS FOR A 20 MW FeSi 75% DUST CONTROL SYSTEM (all figures in US dollars)

Ducts from stack to filter, + preseparator (depending on duct length).....	200 000	
Main fans.....	150 000	
Baghouse.....	2 500 000	
Dust handling, silo, etc.....	150 000	
Electrical equipment, motors, starters, lightning.....	350 000	
T O T A L, including erection.....(± 20%) (excluding foundations)	3 350 000	U S D

This is a budget price to give an order of magnitude of the costs involved.

4/ FUTURE TREND

If the cost of energy becomes low again, as we see it going, it will be wise to build large baghouses, with glass bags, on open type furnaces : less problems around the furnace, more flexibility in the filter operation, less components in the dust control system.

If the price of energy goes up again, the semi closed furnace with heat energy recovery will again be favoured. In any case, the baghouse will be the best solution. Also, in any case, such baghouse should be built by engineers having a large and successful experience in the Ferro-alloy application.

5/ ARE THEY WAYS OF UPGRADING EXISTING BAGHOUSES ?

Some baghouses have been built in the last 20 years by people who either had no experience in the field, or had the wrong approach.

Bag life :

Nomex bags are expensive and last only 12 to 18 months. Filters have been and can be successfully converted from Nomex to glass. The hardware of the baghouse must be checked and eventually modified, but the switch from Nomex to glass is worth It.

Life of glass bags can also be increased by improving the baghouse operating conditions (valves, cycles, pressures, temperatures, ventilation, suspension, etc...)

Some modifications have been made on different existing types of filters with great success.

Dust handling

If the dust handling equipment does not work well, the filter is stopped very often, and the bags have a poor life.

Upgradings of existing dust handling equipments have been successfully made in France, Canada, Germany, on existing filters, and replaced by very simple and reliable low pressure dust conveyors.

Bag house components

Valves and bags attachments are the last but not the least of the factors influencing the life of bags and the cost of operating the baghouse(energy costs, maintenance costs). They should be thoroughly checked when rewamping a filter.

CONCLUSION

A lot of ferro-alloys producers have been, or will be, forced to install a dust control system for their electric arc furnaces. It is expensive equipment to purchase and to operate, and it has practically no "return on investment". The inner company pressure to purchase the cheapest equipment is very strong.

However, most of the companies who have chosen the "cheapest" solution have spent more money in trying to later improve the system than any price difference between the "best available - most experienced system" and "the cheapest". It did not help to ask from these baghouse manufacturers written guarantees, since a guarantee based on no experience is worth nothing. Later legal actions are then useless due to the technological complexity of the cases, and the difficulties to prove the errors.

Gentlemen, thank you for your attention. This presentation might have stayed in generalities, but being short enough, we might now go into details by answering your questions.