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ELIMINATION OF NOISE FROM BURNERS BY REPLACEMENT WITH HEATERS

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INTRODUCTION

Although electric arc furnaces and induction furnaces are dominating sources of noise in steelworks and foundries, there is a number of "secondary" noise sources which also contribute strongly to the total noise there. Among these "secondary" sources are oil burners which are used for pre-warming large ladles prior to transferring molten steel to them from the furnaces for transport to other parts of the works.

A typical way for noise control engineers to attack such noise problems is to concentrate on modifications of the noise producing equipment. Often this results in moderate noise reductions and increased costs. In most cases this appears to be unavoidable. A less common but sometimes possible method is to replace the equipment with better technology which produces less noise and is less expensive to operate in the long run. Here I propose that this latter approach should be part of the noise control engineer's method, and I present an example of such technology. My example is replacement of noisy oil burners by quiet electrical heaters.

OIL BURNERS

Previously I studied noise generation in oil burners in a steelworks with special emphasis on infrasound generation [1]. The oil burners are used to pre-heat ladles for transport of molten steel. Normally it takes about an hour to pre-heat such a ladle to about 800 C. Noise levels at ten meters distance were typically over 90 dB at frequencies between about 20 Hz and about 100 Hz. This noise dominates in a large area around the oil burners and is very difficult to reduce by sound absorbers or the like. Only small improvements were possible through modification of the air fans supplying the oil burners. Thus the noise problem was not solved.

ELECTRICAL HEATERS

In 1977 an electrical heater for six ton steel ladles was successfully built and tested [2]. In fact electrical ladle heaters with ordinary metallic resistance elements have been known for at least twenty years, but they have been subject to breakdowns and too long heating cycles, as well as insufficient final temperatures, and were thus unsuccessful. Also, until 1973 oil and gas were plentiful at favorable prices, making competition with electricity difficult. After 1973 the oil situation changed radically. In 1977 a heater was built using Kanthal heating elements which have better mechanical and thermal properties than the previous metallic heating elements. Using the Kanthal elements breakdowns were dramatically reduced, the electrical power rating was increased reducing the heating time, and the operational temperature was increased making it possible to heat the ladles to 800 C. The noise level from the electrical heater is usually below the general noise level in the foundry (under 76 dBA at 1.5 meters distance). This is clearly a far better solution to the present noise problem than adjustment of air fans for oil burners.

The heater in question has 14 Kanthal heating elements mounted on a lid as shown in the figure. When a six ton ladle is raised up against the lid the elements hang down vertically inside the ladle. The actual heating of the ladle lining is mostly by infrared radiation, rather than by convection. This is due to the high temperature of the elements, around 1700 C.

It takes about an hour to heat the ladle to 800 C with the heater rated at 160 kW. The elements are connected in series to a line voltage of 380 volts and the current, normally about 300 to 400 ampères, is regulated by thyristors. The heat load on the ladle inner lining is about 4.4 watts/cm^2, which appears to be a good number for dimensioning heaters for other ladle sizes. For instance for a 22 ton ladle about 440 kW from 30 heating elements is required.

ECONOMIC CONSIDERATIONS

The decision to replace oil burners with electrical heaters must be based mainly on economic considerations, and only secondarily on noise considerations. In the present case a complete electrical heater installation should cost around US $ 50 000. Based on today's oil and electricity prices in Sweden this investment can pay for itself in less than a year under normal operating conditions.

This is dependent on the relative prices of oil and electricity and due to the high thermal efficiency of electrical heat (infrared radiation) compared to the considerable heat losses due to exhaust gases from oil burners. Clearly this noise reduction step is economically attractive as well as an improvement in the work environment.

DISCUSSION

Here the development of noise reduction work on heaters has been presented in two steps. They can be summarized as follows:

step 1. Concentration on "instant" noise control using installed equipment and known technology. Not successful.

step 2. Identification of a new technology and its implementation. Highly successful.

Similar solutions using electrical heaters can undoubtedly be implemented in other industrial contexts. An example is furnaces for glass. From the point of view of noise control engineering this requires cooperation between noise control engineers and industry on a somewhat different level than "normal" consulting.

Peter K Baade expressed somewhat similar thoughts several years ago [3]: "To control noise in a cost effective manner takes more than bigger and better boxes: it takes a concerted and unwavering effort over a time span long enough to develop whatever technology is missing and to implement the results in a new design." There are many examples of such efforts: aircraft engine noise reduction and the development of quieter control valves are two. Today's development of new materials using powder metallurgy, ceramics technology, plastics, and electronic systems give us many alternatives and possibilities for true innovation. Especially modern high temperature ceramic fibers show promise in noise control engineering, for example in steelworks. It is important that we noise control engineers become machine and process innovators in order to carry out our real mission in noise control engineering.

REFERENCES

[1] D H McQueen, "Reduction of infrasound generation in an industrial oil burner" Acustica 42, 181-184 (1979).

[2] Bulten-Kanthal AB, Kanthaldivisionen, 734 81 Hallstahammar, Sweden.

[3] Peter K Baade, "Instant noise control?" editorial, Noise Control Engineering 15, 54 (1980).

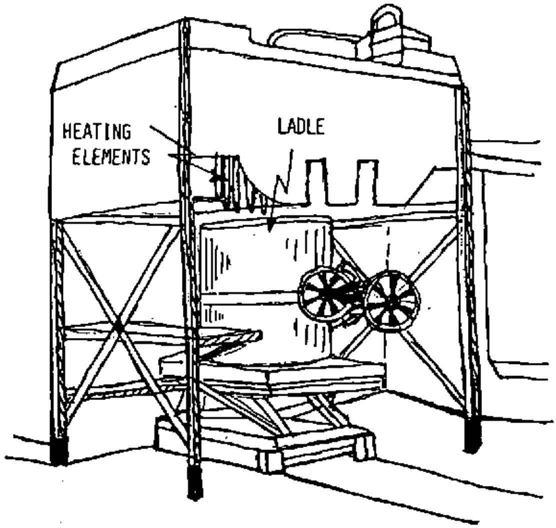

Figure showing a six ton steel ladle under the electrical heating elements for pre-heating the ladle.