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ON TWO TYPES OF LOW FREQUENCY NOISES FROM BOILER SYSTEMS

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INTRODUCTION

According to our experiences, there are two types of low frequency noises from boiler systems.
(1)Case A : Noises due to combustion; When burning rate is increased, apmlitude of pressure pulsation is increased.
(2)Case B : Noises due to blowers; There may be two types of case B. B1) Due to surging phenomena of blowers at low rates of air flow; When burning rate of a boiler and flow rates of a blower are decreased, amplitude of pressure pulsation of inlet or exit of blower system is increased. B2) Coupled pressure oscillation in a chamber with a blower at a normal rate of air flow.

CASE A : WHEN BURNING RATE IS INCREASED, SPL OF NOISE IS INCREASED

Fig.1 shows spectra of noises(in Lin. scale) of a boiler for central heating system, at a point near to an exit of an exhaust pipe. SPL is about 107dB at 25Hz. When burning rate is reduced from a normal load, SPL is considerably reduced to about 91 - 92dB. An improvement of burner system was tried and succeeded to reduce noise level by about 10dB. Fig.2 shows another example, which was taken at a point near holes of a boiler. This boiler was beeing used for burning of waste fuel in a petrochemical factory. Normally, there came big noise of 120dB at 25Hz. Noise level reached to 85dB(scale A) due to chattering of window glasses at residential houses which located about 450m from the boiler.

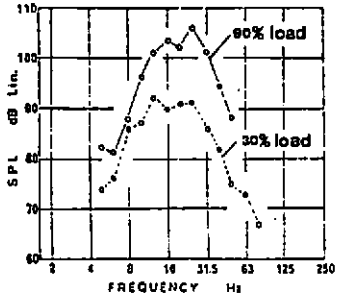

Fig.1 Band spectrum near to an exit of an exhaust pipe of a boiler

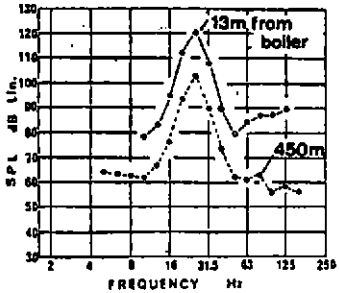

Fig.2 Band spectrum of a boiler in a petrochemical factory

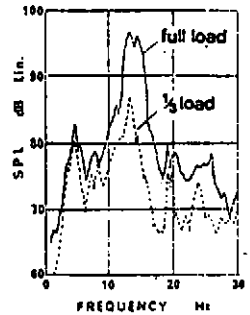

Fig.3 SPL spectrum at a point close to a wall of a big boiler

Improvement to reduce burning rate of fuel was done. After about one year's effort, they succeeded to get low level of noise from the boiler and social problems of chattering noise of residential houses were completely solved. Fig.3 shows another example of a noise spectrum at a point close to a wall of a big boiler of an electrical power station. At a full load, SPL(dB0 is 97dB(13Hz), but for a 1/3 load, SPL is 87dB(13Hz).

CASE B1 : WHEN BURNING RATE AND FLOW RATE OF BLOWER IS DECREASED, SPL OF NOISE IS INCREASED

Fig.4 shows spectra, taken at a 45m point from a chimney of a boiler. This boiler is used to produce steam for driving turbines and cargo oil pumps in an oil tanker. At a normal rate of burning(normal load), SPL is 70dB at 7.5Hz. But when running of cargo oil pump is stopped by a low rate of burning(almost no load), SPL increases to 83~84dB(7.5Hz) and window glasses of residential houses near this tanker make big noise. For decreasing load, a controlling valve

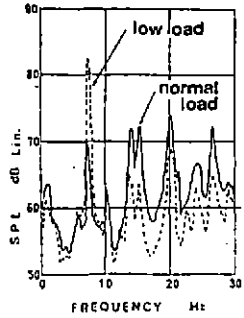

Fig.4 SPL spectrum at a 45m point from a chimney of a boiler

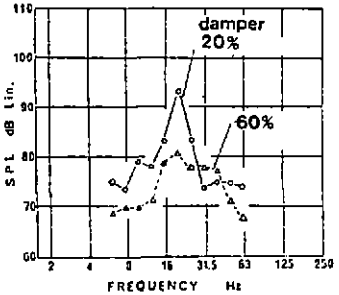

Fig.5 Band spectrum at an inlet of FDF

of a blower(FDF) is throttled. It seems that there comes resonant pressure pulsation in the combustion chamber of the boiler, coupled with surging phenomena of the blower. Fig.5 shows another example of noise spectra at the inlet of a forced draft fan(FDF) of a boiler. When the opening of a controlling valve at the inlet side of the blower is set at 60%, noise level is 81dB(20Hz), but when the opening is at 20% for a low rate of burning(a partial load), noise level increases to 93dB(20Hz). Namely, when load of boiler and flow rate of the blower are decreased by throttling a controlling valve, noise level is increased. So, we may assume that this type of noise does not come from combustion, but from surging phenomena of blowers. We designed a special silencer of low frequency type, which is to be attached to the inlet of the blower system, as shown in Fig.6 and SPL at the inlet was expected to decrease by about 10dB.

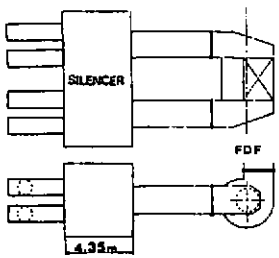

Fig.6 silencer for low frequency noise

CASE B2 : COMBINED PRESSURE PULSATION IN A COOLING CHAMBER WITH AN INDUCED DRAFT FAN (NORMAL FLOW RATE)

At an electrical power station, there happened a big low frequency noise (about 96dB at 10Hz, Fig.7) from walls of cooling chambers of desulphurizing plant. At first, we imagined that there would be a kind of pressure oscillation due to cooling in a chamber, just like due to combustion in a boiler. But it was not true. Even when water is not supplied, SPL is not changed. So, we adopt another assumption that there will be enough noise level of 10Hz from IDF to make a coupled pressure vibration in the cooling chamber. Model experiments were done. We also tried to get a good profile of a silencer. Fig.8 shows an actual silencer which was installed to the delivery side of IDF. Noise level is decreased by about 18dB at 10Hz(fig.7).

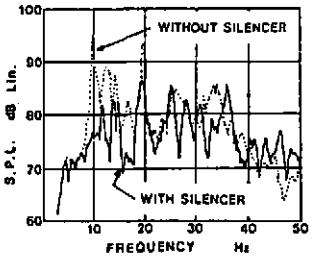

Fig.7 SPL spectrum near the wall of cooling chamber

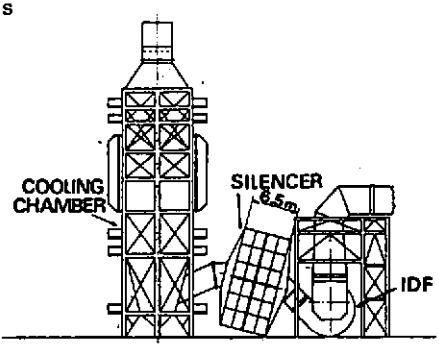

Fig.8 an installed silencer

RESUME

1) When strength of pressure pulsation due to combustion of fuel is enough strong, there will be resonant low frequency pressure oscillation in a combustion chamber. (case A)
2) When strength of pressure pulsation due to surging of FDF (at a reduced rate of air flow) is enough strong, there will be a resonant low frequency pressure oscillation in a combustion chamber for a low rate of burning of fuel. (case B1)
3) When strength of pressure pulsation due to noise from IDF (at a normal rate of air flow) is enough strong, there will be a resonant low frequency pressure oscillation in a cooling chamber. (case B2)