Noise	Abrupt Change in Noise Level from Steam Discharge Silencer	Other Equipment
Noise		

Object Machine

Silencer for boiler steam discharge (capacity 120T/H)

Observed Phenomena

During trial, noise level increased in response to the increasing steam flow, and at a certain steam flow rate, the noise level suddenly decreased by about 10dB together with the emission of impulsive sounds like “bari-bari”. The noise level again increased thereafter, while a large hysteresis characteristic appeared when the flow rate decreased.

Cause Estimation

Among the following assumed reasons, self-excitation under Items (1) and (2) was estimated to be most liable in consideration of abrupt change by 10dB.

(1) Noise due to Self-excited vibration: valve

(2) Noise due to air column resonance and so on: cartridge honeycomb, valve cage, whistle blowing from a perforated plate of silencer

(3) Change in flow field, acoustic interference with shock wave: valve cage producing choke flow, silencer cartridge, silencer diffuser without choking.

For some time now, opening inspection was carried out, but no abnormality was identified at all.

Analysis and Data Processing

Fig.2 shows the trends of machine side noise versus valve opening, while their spectra are given in Fig.3. As the spectra have a broadband, it estimated that the cause was not self-excited phenomenon originally considered highly liable but the above Item (3). Also, judging from the vibration of each part in Fig.3, it was estimated that the valve is not in the least the cause, while the silencer cartridge or the silencer itself would have caused this phenomenon.

(i) Abrupt enlarged portion of the piping on the outlet of the silencer cartridge

(ii) Abrupt enlarged portion of the silencer inlet

Countermeasures were planed based on the item (3), because no further analysis was considered.

Countermeasures and Results

-As for (i) above, the abrupt enlarged portion was smoothly taper-enlarged.

-As for (ii) above, the inlet piping was extended into the silencer inside, and made as a diffuser.

-The splitter on the silencer inlet side was extended by 1m (for reducing the noise level).

As a results of some reasons, the measures except to priority item (ii) carried out. The resultant noise level became a very low and no hysteresis characteristics was observed.

In these measures, however, influence on the flow might give to the cartridge portion, so that the portion of cause have not been strictly identified.

Lesson

As for this phenomenon, a quick action carried out by information from experiences in this field and by a related paper founded. Frankly speaking, it is doubtful if this phenomenon could be dealt with adequately by personal consideration. After all, experience and database are important in solving these problems.

References

Transaction of the Japan Society of Mechanical Engineers B, Nakano et al.,No.55-520, 1989, pp 3716-3732

Keywords

Fluid sound, shock wave, choked flow

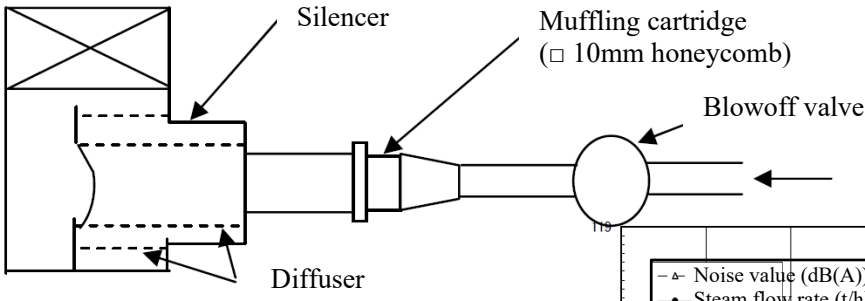

Fig.1 Steam discharge system

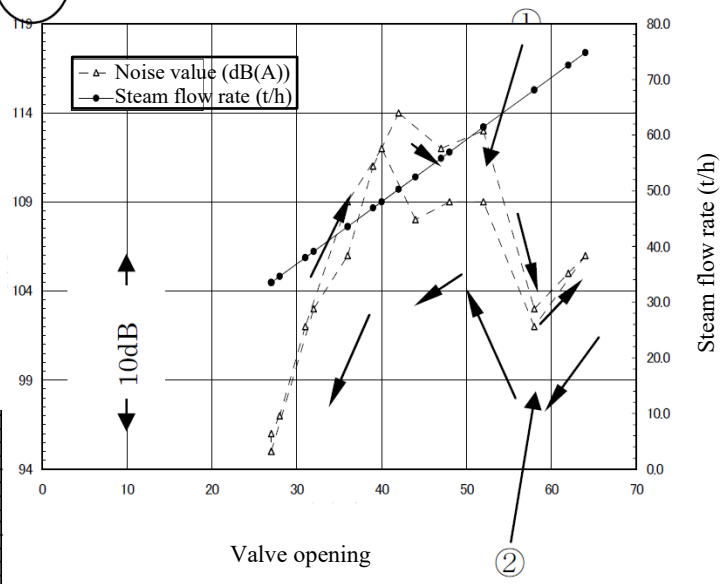

Fig.2 Noise trend with respect to valve opening

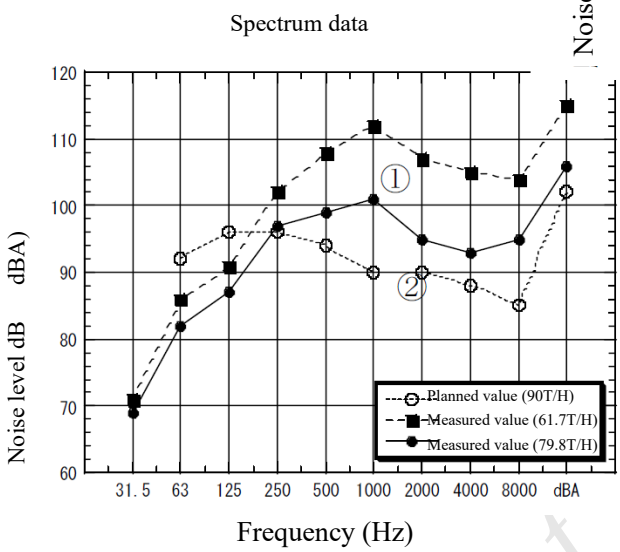

Fig.3 Noise spectra

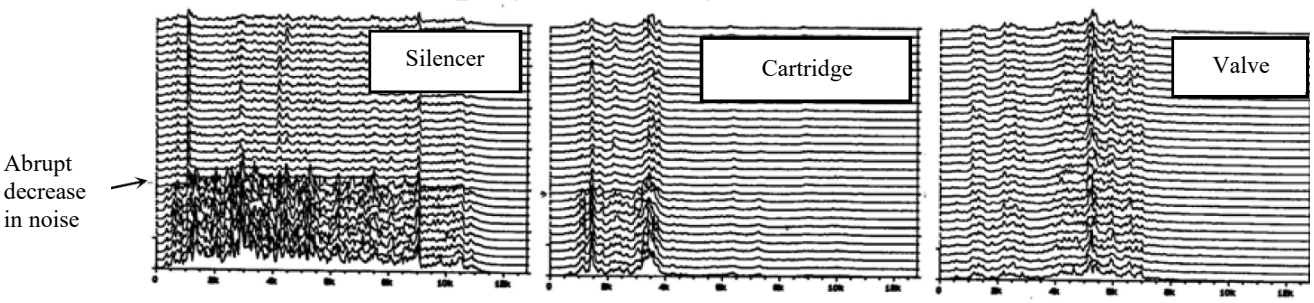

Fig.4 3D diagram of vibration data (horizontal axis: full scale = 12kHz)