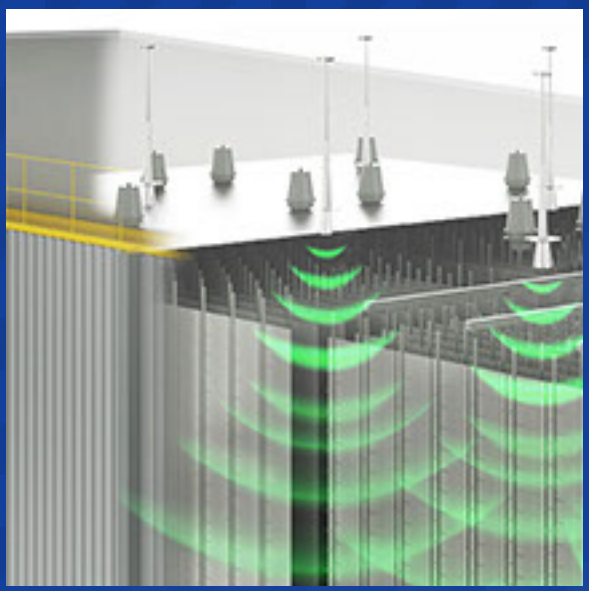
Technology overview

By means of acoustic cleaning, particles in dry form, such as cinder and soot, powder and flour, can be removed from places where they are not desired. Sound travels conically in space; consequently, the Nirafon acoustic cleaning system is effective in fringe areas and around corners, enabling the cleaning of surfaces that are inaccessible by other means.

The accumulation of ash and other combustion residues on the structures of boilers is a familiar but annoying problem at power and heating plants. Energy producing and process industries use acoustic cleaners for cleaning different surfaces inside the plants. The method works best for removing powder type materials from surfaces without interrupting the process.

Acoustic Cleaning System consists of a sound emitter best suited to different conditions. The frame, the cover and the membrane form the sound generator unit. The membrane inside the sound generator works as a valve, loaded by pre-tensioning of the frame and the cover, compressed air, the acoustic impedance of the horn, and the spring back factor, formed by the air space on the other side of the membrane.



NIRAFON
acoustic cleaning systems

Technology overview

THE TRAVELING SOUND

The sound travels spherically in space and cleans hidden surfaces, surfaces at blind angles and around corners. In other words, the sound is deflected, adapting to uneven shapes so sound can be successfully used for cleaning surfaces inaccessible by other means.

The deposits adhering to the surface are subjected to a force greater than that retaining it. The particles with different masses are subjected to alternating sound waves. Because the particles have different masses, the distance they travel is a little different. When the sound impact is repeated with appropriate frequency the particles go out of phase with each other and break apart. The required frequency of impacts depends on the amount of deposits, their natural vibration frequency and adhesiveness. When the impact on the deposit is frequent enough, the deposit comes off and the surface is clean.

The horn is an acoustic corrugated tube, of which cross-section changes continuously. The design of the horn effects the frequency division of the created sound. When the air column inside the horn is made to oscillate, its oscillation frequency will mostly depend on the length of the horn in such manner that its basic frequency is thereto in inverse relation. The basic frequencies of the Nirafon pneumatic acoustic cleaners are the same as the numbers in their product names: NI250 = 250 Hz, NI100 = 100 Hz, NI60 = 60 Hz.

SOUND FREQUENCY

The basic frequency of the acoustic cleaner, together with its harmonic overtones, creates the cleaning effect of the device. Prior experiences show that in most cases a sound pressure level of 130 dB at the area to be cleaned is sufficient for effective cleaning, if the temperature remains under 800 °C.

NIRAFON® acoustic cleaners create a sound pressure level of about 150 dB, measured at one-meter distance from the mouth of the horn.

The operation of an acoustic cleaner depends on supply of compressed gas. In most applications, the gas is normal industrial pneumatic air. However, if air is hazardous for the process, e.g., there is a risk for explosion or harmful oxidation, then the acoustic cleaner may receive its operation energy from nitrogen, for example.

Pneumatic air is used for cleaning and for cooling the sound generator. The table below indicates the acoustic cleaner's consumption of free air. As soon as the cleaning frequency is known, it is possible to calculate the daily consumption of air by the acoustic cleaning system. Acoustic Cleaner's Air Consumption:

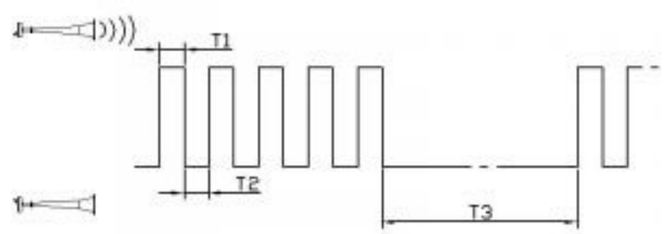
Air Consumption
Cooling 2 Ndm3/s continuously
Cleaning 20 Ndm3/s during sounding with NI250 cleaner)
Cleaning 40–50 Ndm3/s during sounding with NI100 and NI60 cleaners

Because impurities of supply air may harm the forming of the sound or cause physical damage to the membrane, the acoustic cleaner has its own filter / water separator unit. Its function is to separate any solid particles and water from the compressed air. The water separator has to be emptied from the rubber swimmer valve at the bottom of the cup by turning the valve carefully. If the amount of water is affluent, it is possible to discharge it to the sewage through a tube.

The pressure level of pneumatic air before the solenoid valve must be at least 6 bar. During sounding, the pressure at each separate cleaner must always meet the minimum of 4 bar. The effectiveness of acoustic cleaning not only depends on eventual impurities, but also on the temperature of the intermediate agent, the surface area of absorbent surfaces, and the structure of the elements to be cleaned. These factors regulate the required time for sounding and the number of required acoustic cleaners.

The most advantageous situation for staring acoustic cleaning is when the object is clean to begin with. In such case, the sound oscillation will prevent any particles from attaching to the surface.

Usually the operation of an acoustic cleaner is carried out in pulses because, as indicated by tests, the most important time of the sounding is its start. Long sounding periods are useful if the amount of deposits is big. The drawing below is a presentation of a typical operation sequence of an acoustic cleaner.



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NIRAFON OY
Kallio-Pietilankatu 1
15800 Lahti Finland
+358 (0)207 780 840
nirafon@nirafon.com
www.nirafon.com