Brecon Vibrationstechnik GmbH, 50933 Cologne, Germany

Simple measurement of the frequency and amplitude of vibration

The field of vibration technology is of importance in almost all industries. The two largest areas of application are to be found in conveying equipment and the concrete industry. However, not only concrete is compacted by means of vibration in order to improve its mechanical properties. Every chocolate, many cast plastics and also powdery bulk goods are compacted using vibration. If used correctly, vibration improves the flowability of both liquid and solid materials. The key parameters are thereby the amplitude and the frequency of the vibration used. The two together are decisive for the vibration energy applied to the medium.

Georg Conrads,
Brecon Vibrationstechnik GmbH, Germany

An incorrectly selected frequency when compacting concrete may not produce the desired effect. This is also possible if the frequency is correct, but the amplitude does not suit the medium on account of the centrifugal mass being too small. The medium to be compacted mostly consists of a mixture of grains of different sizes. Since fine grains basically require a higher frequency and coarse grains a lower frequency, it is useful for the compaction of concrete if the frequency can be varied during the compaction procedure.

Error analysis in the case of product defects

The vibration parameters are of no interest to the user as long as the desired compaction effect is achieved. However, if there are defects in the end product, the amplitude and frequency parameters become important factors in the rectification of the defects. The synchronicity of two or more vibration motors can similarly be of interest, since the frequencies of the vibrators may negatively influence one another under certain circumstances. However, the synchronous running of vibration drives can only be reliably determined using a high quality and comparatively expensive stroboscope (fig. 1).

In terms of measurement technology, it becomes more complex if the amplitude is to be analysed at various measurement points simultaneously or if the entire vibration behaviour of part of the plant is to be analysed via a time window. The measurement of synchronous running is therefore out of the question for most users.

Simple measuring instruments for users

There is, however, a simple possibility for the user to determine for himself the frequency and the amplitude of vibration drives with sufficient accuracy and, hence, to possibly determine the cause of a change.

Amplitude measurement

Using a small aid, the so-called "Brecon magnet" (fig. 2), amplitudes from 1 – 10 mm can be quickly determined with an accuracy of around half a millimetre. The Brecon magnet consists of two strong circular magnets, to which an aluminium plate with printed circles is adhered. If this aid is placed on an evenly and sinusoidally oscillating steel surface, the ten circles with diameters from 1 to 10 mm are seen twice, namely at the reversal points of the oscillation.

The diameter of the doubly visible circle, where the two circles appear only to touch at one point like billiard balls, indicates the amplitude.

The technical term amplitude is consciously used incorrectly here, since in common speech the amplitude is usually equated to the entire oscillation range. However, the amplitude is actually only half of the deflection of an entire sinusoidal curve.

If a double circle, e.g. 4 mm, does not quite touch, but the next larger double circle, e.g. 5 mm, slightly overlaps, then the amplitude is around 4.5 mm.

Frequency measurement

There is also a small mechanical aid for measuring the frequency. The principle is based on the resonant behaviour of a spring steel wire, which is held against the oscillating structure. Its length is thereby changed until the wire suddenly deflects very strongly. Fig. 3 shows the palm-size device; the wire

Fig. 1: The precise measurement of frequency, amplitude and synchronicity requires expensive measuring instruments

Fig. 2: The amplitude can be determined very quickly using the Brecon magnet

Fig. 3: The frequency measuring aid in a resting state

Fig. 4: The resonant oscillation indicates the momentary frequency

is pushed out of the housing by means of turning the upper part. When the wire resonates, the upper part of the housing indicates the determined frequency on a scale (fig. 4).

What the two small aids mentioned have in common is that they work without electricity and fit in every jacket pocket. The frequency measuring device can be used from 800 to 20,000 oscillations per minute.

However, use is limited due to the coarse results. Above all, small amplitudes of less than one millimetre, which are chiefly used in the compaction of wet concrete, cannot be assessed. Expert support is advisable in such cases.

Operation with frequency converters:

Users who operate vibration motors on their plants via electronic frequency converters additionally have the possibility to read off the electrical frequency from the frequency converter. Armed with the knowledge of whether the motor is a 2-pole or 4-pole three-phase motor, the mechanical oscillation frequency can be determined very accurately. In the case of 2-pole motors, the mechanical frequency is approximately equal to the electrical frequency. In the case of 4-pole motors the mechanical frequency is only half the electrical frequency. The best-known example of this is that so-called 200 Hz motors run with a speed of approx. 6,000 rpm, i.e. at a mechanical 100 Hz (6000/60). However, what all three-phase motors have in common is that the actual rotary speed is lower than the nominal rotary speed. Therefore, the display on the frequency converter can only be taken as an approximate value for the vibration frequency.

Synchronous operation

There is, however, an exception: synchronous running vibrators, which have been available since 2004, are the only wet concrete compacting vibrators in the world where the exact vibration frequency can be read off directly from the frequency converter at any time, because they run in absolute synchronisation with the frequency shown on the frequency converter. Since the synchronous running vibrators are 2-pole, the displayed electrical frequency is also identical to the mechanical frequency. That not only makes all measuring instruments superfluous, it also means absolute reproducibility in the decisive process, namely the compaction of the concrete.

Conclusions

The key parameters for vibration, amplitude and frequency, can be determined with sufficient precision in practice using small aids. For installations in which the vibration motors are operated via frequency converters, there is an additional possibility to derive an approximate value for the mechanical frequency from the electrical frequency. The requirement for this is that it is known how many pole pairs the vibration motors have. In the case of synchronously running vibration motors (2-pole), the mechanical and electrical frequencies are identical.

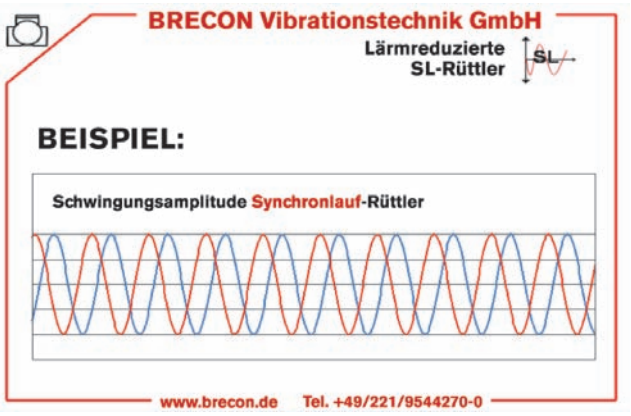

Fig. 5: the mechanical and electrical frequencies are only absolutely identical with the synchronous running vibrator; the exact rotary speed can therefore by read off from the frequency converter

FURTHER INFORMATION

BRECON

Brecon Vibrationstechnik GmbH
Stolberger Strasse 393
50933 Köln, Germany
T +49 221 9544270
F +49 221 9544277
info@brecon.de
www.brecon.de