1、In my past years of career, I served one technical company which is professional in machinery detection, faults diagnosis, and maintenance service. The company is one of subsidiaries [səbˈsɪdiəri] of China Baowu Steel Group Corporation, which is the biggest Iron and Steel manufacturing enterprise in China. It sets up the control mode of “1 head office and multiple bases” with combination of professionalized focus and regional synergy, to realize the high-quality development with a scale “exceeding hundreds of million tons ”.

2、In China Baowu, there are great numbers of rotating machineries and moving structures such as motors, fans , pumps, gearboxes and drive-trains. (electric drive , Hydraulic transmission, Pneumatic **[njuːˈmætɪk]** transmission)

3、Anytime a piece of machinery is running, it is making vibrations. Vibration is a physical phenomenon that presents itself in operational rotating machineries and moving structures. *Vibration can be induced by various sources, including rotating shafts, meshing gear-teeth, rolling bearing elements, rotating electric field, fluid flows, combustion events, structural resonance and angular rotations. A complex machine with many components will generate a mixture of vibrations, which is a combination of vibrations from each rotating components.*

4、The studies of sound and vibration are closely related. Sound, or pressure waves, are generated by vibrating structures (e.g. vocal cords); these pressure waves can also induce the vibration of structures (e.g. ear drum). Abnormal vibrations always accompanies abnormal sounds.

In the past, because of lack of vibration analysis tools, many experienced maintance staff/engineer use Listening Stick to listen to pumps, compressors, motors and other rotating equipments. The normal running sound of the equipment is stable, smooth, even and without harsh noise(such as the rubbing sound of metal). they can correctly judge (analyze, diagnose, investigate) the operation of the equipment with experience accumulated through listening and comparing frequently before.

“”Previous experience in developing products or platforms that leverage [ˈliːvərɪdʒ] acoustic [əˈkuːstɪk] technologies are a distinct advantage for this role…“”

5、Vibrations can be represented in different forms, including displacement, velocity and acceleration. Acceleration places greater importance on high frequencies. displacement looks at low frequencies. Velocity is related to the destructive force of vibration, making it the most important parameter. It places equal importance on both high and low frequencies.

Monitor critical equipment, Monitor heavily used equipment, Monitor difficult-to-access equipment

6、Vibrations can be described both in intensity [ɪnˈtensəti] by amplitude and in periodicity by frequency.

Vibration analysis is a process that monitors vibration levels and investigates the patterns in vibration signals. It is commonly conducted both on the time waveforms of the vibration signal directly, as well as on the frequency spectrum, which is obtained by applying Fourier Transform on the time waveform. Time domain vibration analysis is able to monitor vibration levels. Frequency domain vibration analysis excels at detecting abnormal vibrating patterns.

7、A vibration monitoring system is a complete system that is capable of acquiring vibration signals according to pre-determined parameters such as sampling frequency, vibration level, recording length, recording intervals and frequency bandwidths. The system should be able to process the recorded vibration and translate the information to intuitive indications for the machine operators, maintenance staff or asset managers.

Vibration analysis is defined as a process for measuring the vibration levels and frequencies of machinery and then using that information to analyze how healthy the machines and their components are.

Anytime a piece of machinery is running, it is making vibrations. An accelerometer /sensor attached to the machine generates a voltage signal that corresponds to the amount and the frequency of vibration the machine is producing, usually how many times per second or minute the vibration occurs.

All data collected from the accelerometer goes directly into a data collector (software), which records the signal as either amplitude vs. time (known as time waveform), amplitude vs. frequency (known as fast Fourier transform), or both. All of this data is analyzed by computer program algorithms, which in turn is analyzed by engineers or trained vibration analysts to determine the health of the machine and identify possible impending problems like looseness, unbalance, misalignment, lubrication issues and more.

8、Maintenance today are asked to run with fewer staff and smaller budgets, with these requirements we design and develop series of Vibration Monitors and Collectors. and I engage in needs clarify, specification confirm, firmware program, function test, quality detection, technical support

Vibration is a mechanical phenomenon whereby oscillations occur about an equilibrium [ˌiːkwɪˈlɪbriəm] point. In many cases, however, vibration is undesirable, wasting energy and creating unwanted sound. For example, the vibrational motions of engines, electric motors, or any mechanical device in operation are typically unwanted. Such vibrations could be caused by imbalances in the rotating parts, uneven friction, or the meshing of gear teeth. Careful designs usually minimize unwanted vibrations.

Vibrations can be represented in different forms, including displacement, velocity and acceleration.

Vibration analysis technique is capable of identifying almost all the faults that a machine can have. As a result, occasional analysis needs complementary methods to confirm a diagnosis. The following are the most common faults that vibration analysis identifies:

Imbalance、Bearing failures、Mechanical looseness、Misalignment

Resonance and natural frequencies、Electrical faults in motors

Bent shaft、Gearbox failures、Cavitation in pumps、Critical speeds

**What Can Vibration Analysis Detect?**

Time domain vibration analysis is able to monitor vibration levels. Acceptable operation vibration limits can be pre-defined either through long-term operation and maintenance history or through referring to established standards. If the limit is breached, this could be that the overall health condition of the machine is deteriorating and defects have developed.

Frequency domain vibration analysis excels at detecting abnormal vibrating patterns. For instance, a crack that has developed on a roller bearing outer race will lead to periodic collisions with bearing rollers. In time waveform, this information is usually hidden and masked by the vibration from other sources. By studying the frequency spectrum, the periodicity of the collisions can be discovered and thus detect the presence of bearing faults.

**How Do You Measure Vibration?**

Vibration can be measured through various types of sensors. Based on different types of vibrations, there are sensors designed to measure displacement, velocity and acceleration, with different measuring technologies, such as piezoelectric [paɪəzoʊəˈlɛktrɪk] (PZT) sensors, microelectromechanical sensors (MEMS), proximity probes, laser Doppler vibrometer and many others.

PZT sensors, the most commonly used sensor, generate voltages when deformed. The voltage signals can be digitalised and translated to represent the vibrations. When selecting suitable vibration sensors, the vibration levels/dynamic range and maximum frequency range/bandwidth should be considered, as well as the other operating environment such as temperature, humidity and pH level.

Sensor installation is critical for ensuring that high quality data is recorded. The recommended method for installing sensors is to stud mount the sensor on a flat and clean surface on the machine. This ensures that a broad and smooth frequency spectrum is captured. When stud mount is not applicable, magnet holders, wax or glue can be adopted as substitutions with vibration levels and frequencies considered.

Vibration signals are usually below 20 kHz, except for certain vibration resonances that can reach beyond that. In practice, the sampling rate should be carefully chosen, to make sure that the bandwidth containing frequencies of interest are captured. Additionally, the recording length for one measurement should be at least several periods of the lowest speed of the machines.

**What is a Vibration Monitoring System?**

A vibration monitoring system is a complete system that is capable of acquiring vibration signals according to pre-determined parameters such as sampling frequency, vibration level, recording length, recording intervals and frequency bandwidths. The system should be able to process the recorded vibration and translate the information to intuitive indications for the machine operators, maintenance staff or asset managers.

The system should not interfere the normal operation of the machines or structures that are being monitored and the benefits of the system should be higher than the cost of implementing the system.

**What Are Some Industrial Applications of Vibration Analysis?**

Vibration analysis is predominantly applied for the condition monitoring on machineries and their key rotating parts, including but not limited to:

* Bearings, gears, shafts, free wheels
* Rotating machines such as gearboxes, motors, fans and drive-trains
* Reciprocate machines such as piston engines, reciprocate compressors, pumps and door mechanisms