ABSTRACT

Gears have been in use in various machines since the dawn of industrial revolution. They are among the most important power transmission elements. Their healthiness is integral to the health of various machines in power plants, process industry, etc. In this backdrop, condition monitoring of the gears assumed a vital role for the predictive maintenance and overall smooth operations of the machines.

Many condition monitoring techniques are known for the defect detection and diagnosis of the gears. Cepstrum analysis, vibration measurements, acoustic emission, noise monitoring and wear debris analysis are the prominent CM techniques used in industries.

There are many types of gears - spur gear, worm gear, helical gear, etc. However, very few research works have been undertaken for the condition monitoring of worm gear. So, in this piece of research work, the condition monitoring of the worm gear has been given prime importance. Two techniques - acoustic emission analysis and vibration analysis have been used for the health monitoring of the worm gear with pitting and crack defects. A set of experiments have been performed for the AE analysis and vibration analysis of the worm gear with pitting and crack defects of various dimensions at varying speeds from 225 r.p.m to 1125 r.p.m. An effort has been made to gauge the efficiency of different parameters of AE method. AE energy, AE counts and AE amplitude with regard to giving indication about pitting and crack defects. A comparison has been made between AE method and vibration analysis in telling about various defects in worm gear.

Another set of experiments have been performed for the condition monitoring of the spur gear using four techniques-Thermography, Acoustic emission analysis, Vibration analysis and

Acoustic noise. Data for spur gear have been collected at different loads from 1 kg to 7 kg. Here also an effort has been made to measure the efficiency of these methods and compare them in indicating about the pit defects in spur gear.

Later in this research work, two de-noising techniques - Wavelet filtering and Self - adaptive noise cancellation - have been used to de-noise the vibration and acoustic noise signals of spur gear with pit defects and vibration signals of worm gear with pit and crack defects. In both cases, these two techniques have been compared with regard to their de-noising capability of a noisy signal.

Based on the above set of experiments, it was found that the AE energy is better indicator than count and AE amplitude in pit defect analysis in worm gear at lower speed. At moderate and higher speed AE count is more efficient than AE energy and count. Overall vibrations and vibration @ GMF are better indicator of pitting / crack in worm gear than AE analysis. But in spur gear at all speeds AE energy is better than AE count and AE amplitude, AE method is more efficient than vibration analysis, acoustic noise monitoring and thermography analysis. As far as signal conditioning technique is concerned wavelet filtering is better denoising technique than SANC technique.