

## **Dynamic and Vibration Analysis of a Farm Tractor to Harness Energy via Piezoelectric Generators for Increasing the Fuel Efficiency**

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### **Abstract**

Farm Tractors undergo dynamic, vibration energy changes during operation of farm implements. With the help of mechanical equilibrium and weight shift reactions of tractor different parameters of force, wheel base, tyre reactions and CG were calculated. During the vibration analysis of the tractor system (vibration on the chassis or due to air flow resistance- $R_a = C A v^2$ ) by assuming tractor as spring mass system, the vibration noted was of the scale of  $\omega_1, 2 = 36.0$  radians/sec, and 21.5 radians/sec i.e. 5.73 Hz and 3.43 Hz. Piezoelectric materials can convert mechanical stress and vibration movements of the tractor (normal load on the tyres and vibration on the chassis) into electrical energy of high voltage output. When such a material (Quartz, PZT), Ferroelectric in nature, was subjected to mechanical stress or vibrations on lateral or transverse axis, a multilayer generator of a size of  $5 \times 5 \times 2$  mm under a normal load of 10kN could generate energy of 12mJ. This electrical energy was thereafter formatted by a static converter before supplying to a storage system or directly to the site of application, which can also be harnessed by rubber brush actuators and thus can be stored in the super capacitors, lead batteries or super conducting magnetic energy storage devices and hence was used to drive the PTO, AC compressors, portable and non portable electric devices, Gauge and Thermostat valves. Thus reducing the engine load and increasing the fuel efficiency of a farm tractor by manifold thereby decreasing carbon footprints and operational cost.

**Keywords:** vibration, dynamic, piezoelectric-generators, tractor, fuel- efficiency