

## ABSTRACT

Awkward posture of operation with exposure to heat, dust, noise and high level of hand-arm vibration causes severe stress on the hand tractor operator. Indicators of stress like, physiological cost, rating of perceived exertion and muscular fatigue was measured during transportation, rota-tilling and rota-puddling. The level of vibration at handle grip of hand tractor and hand-arm system of operators at metacarpal, wrist, elbow and acromion point was measured. Vibration energy absorption in the hand-arm system was also measured. In order to reduce the level of stress various interventions in the hand tractors were provided at strategic locations. Various types of hand gloves were also used to reduce vibration exposure of hand tractor operators. The effect of these interventions on reduction of vibration was studied.

Rota-puddling operation (17.71 kJ/min) was the most energy intensive operation followed by rota-tilling (14.65 kJ/min) and transportation (11.99 kJ/min). However, rota-tilling operation required maximum muscular effort. It was observed that vibration transmissibility in the hand-arm system was affected by vibration acceleration, direction, posture and mode of operation. Vibration energy absorption indicated that most of the energy was transferred to hand-arm system at lower frequencies i.e. up to 100 Hz.

Isolator with high stiffness (16.3 kN/mm) and high damping coefficient (0.51 N s/mm) was better for reduction of vibration during field operation of hand tractor. Handle grip made of foam rubber was better than the existing one and it reduced vibration acceleration (rms) by 11.31%. Among the various types of hand gloves, designed hand glove (DG) was better than the hand gloves made of cotton, asbestos and leather. Preferential rating of the DG was also highest (8.5 out of 10). However, none of the gloves fulfilled the criteria of ISO 10819 (1996) for anti-vibration glove. The use of interventions in the hand tractor reduced physiological stress, perceived exertion and muscle fatigue of hand tractor operators. The average reduction in energy expenditure rate was maximum during rota-puddling (1.52 kJ/min) followed by transportation (1.41 kJ/min) and rota-tilling (0.35 kJ/min).

Key words: Work stress, Physiological cost, Heart rate, Work related body parts discomfort, EMG, Vibration transmissibility, Vibration energy absorption, Vibration isolator, Hand glove