Tribosystem for Determination of Footwear Slip Resistance under High Sliding Velocities

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Slipping is the greatest cause of fall accidents in occupational settings and occurs when the friction between footwear and surface is below what is required during walking. Numerous mechanical test setups that are commercially available or presented in the scientific literature, however, often lack the ability to replicate the biomechanical conditions from laboratory-reproduced slipping events. This implies a normal load of 400N and sliding velocities as high as 2.5 m/s. Especially sliding velocity is rarely tested above 0.5 m/s (0.3 m/s in ISO 13287 – test method for footwear slip resistance) in most mechanical test setups. Since elastomer outsoles are highly dependent on sliding velocity, it is crucial to test footwear slip resistance under higher sliding velocities, than what is currently being done. Hence, the purpose of this study was to design a tribosystem and test footwear slip resistance under high sliding velocities.
Our large scale pin-on-disc tribosystem consisted of a "pin": a strain gauge-instrumented beam with a shoe last attached, and a "disc": a 8000 mm steel plate (steel number 1.4301). The steel plate was powered by a servo motor (MAC1200, JVL A/S, Denmark) that was mounted on a steel frame below the attached plate. The tangential velocity in the contact point between the shoe and steel disc was adjustable between 0-2.5 m/s. 400 N normal force was achieved by applying weight plates on top of the beam. Five measurements were performed with a rubber shoe for each testing conditions and averaged. The different test conditions comprised of sliding velocities at 0.3, 1.0 and 2.5 m/s, and with glycerine and canola oil as two common floor contaminants. Dynamic coefficient of friction (DCOF) was calculated in the time interval 0.3 s to 1.0 s after initial contact.
The DCOF results showed the following: *canola oil, 0.3 m/s = 0.147 (±0.007); glycerine, 0.3 m/s = 0.210 (±0.016); canola oil, 1 m/s = 0.151 (±0.008); glycerine, 1 m/s = 0.194 (±0.014); canola oil, 2.5 m/s = 0.201 (±0.019); glycerine, 2.5 m/s = 0.202 (±0.024).* These data demonstrate that sliding velocity does affect the DCOF between footwear and surface under contaminated testing conditions. Hence, these data supports the idea, that footwear slip resistance should be performed under realistic biomechanical testing conditions, to provide the most valid slip resistance results.