

Improving E-bike Durability

Improving E-bike mid-drive motor durability through internal humidity management.

Context

The research direction was motivated by surveys conducted by Sonja van Dam and Wertgarantie, which highlighted that 24.2% of e-bike technical failures involve the motor. When an out-of-warranty e-bike motor fails, the whole bike often gets discarded because the high replacement cost of the motor (over €1,000) makes consumers purchase a new e-bike.

The primary cause for premature motor failure was identified as the thermodynamic “breathing cycle.” Standard dynamic seals cannot withstand the negative pressure differentials generated during motor cooling. This leads to moisture ingress, internal condensation, and component failure.



Interaction

To counteract this, this study proposes the Desiccant Cartridge, a modular, injection-moulded polycarbonate unit integrated into the motor housing. Utilizing 10 grams of indicating silica gel, the cartridge absorbs ingressed moisture to continuously maintain the internal relative humidity below the condensation threshold. The design allows non-expert users to execute a simple, tool-free replacement every two years.

The cartridge is threaded on and off by hand and waterproofing is secured by an integrated O-ring.

Saturation

Unsaturated silica gel is orange and the more it saturated with water it will get greener and greener. When the silica gel is fully saturated and green, it has to be replaced with a new orange cartridge.

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Integrated Product Design

Committee

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