Optimization of Pressure Sensitive Adhesive Properties Through Incorporation of Moisture-Absorbing Particles

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Existing moisture-resistant pressure sensitive adhesive (PSA) tape products rely on water-impermeable backings to block moisture. However, such mechanisms are contingent on the moisture arising from the backing side, and prove unsatisfactory when the adhesive side is directly exposed to moisture, as when attached to perspiring skin. The current study aimed to improve moisture-resistance in PSA products through incorporation of moisture-absorbing substances, either through direct mixing into wet adhesive or surface modification of commercial adhesive tapes. Adhesive performance in both ambient and humid conditions were investigated with methods such as the 90º peel test and mandrel test, which were devised from industrial standard methods and implemented at home. Compared to the 90º peel force (kgf) of the original adhesive (mean: 0.22, SD: 0.05), incorporation of 1 wt% baby powder (mean: 0.29, SD: 0.07, $p = 0.008$, 32% improvement) and silica gel (mean: 0.27, SD: 0.06, $p = 0.027$, 23% improvement) through the direct mixing method significantly enhanced moisture-resistance. Meanwhile, mixing at 5 wt%, incorporating a different substance, or incorporation through surface modification each caused a significant drop in adhesion force. These results demonstrate the strong potential of this approach for developing moisture-resistant PSAs, where incorporation of appropriate moisture-absorbing substances synergistically improves the cohesive and adhesive strength of PSAs. Considering the broad usage of PSAs for wound care and other moisture-contacting applications, and the knowledge gap that exists for this line of products, the discoveries made here can help advance the field and benefit practical applications.

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