SILICONE MIGRATION FROM SILICONE COATED RELEASE LINERS & AND THE POTENTIAL IMPACT THIS MAY HAVE ON THEIR APPLICATION

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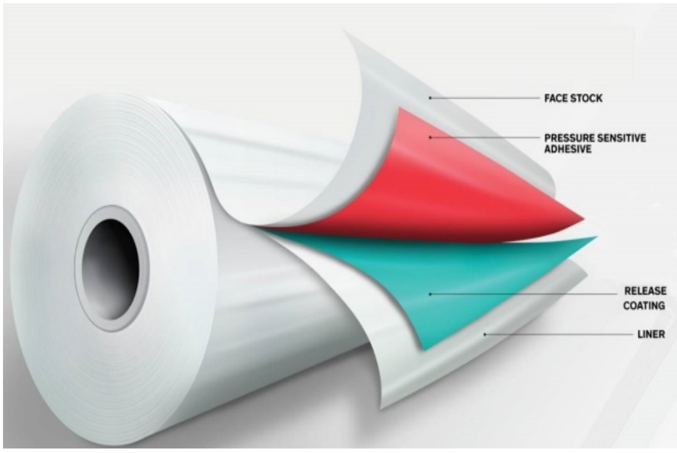
WHAT ARE SILICONE RELEASE LINERS? Silicone Release Liners are an essential part of many 'sticky' or self-adhesive products. The Release Liner performs a number of essential roles in protecting and supporting self-adhesive materials, allowing their subsequent processing (such as die-cutting), before finally 'releasing' the self-adhesive material to be used their final application. The most common applications are for self-adhesive labels and tapes where there often needs to be a protective liner, but release liners are also used in a wide range of other applications where the applied material is only 'sticky' for a specific part of the process (such as in composite release liners).



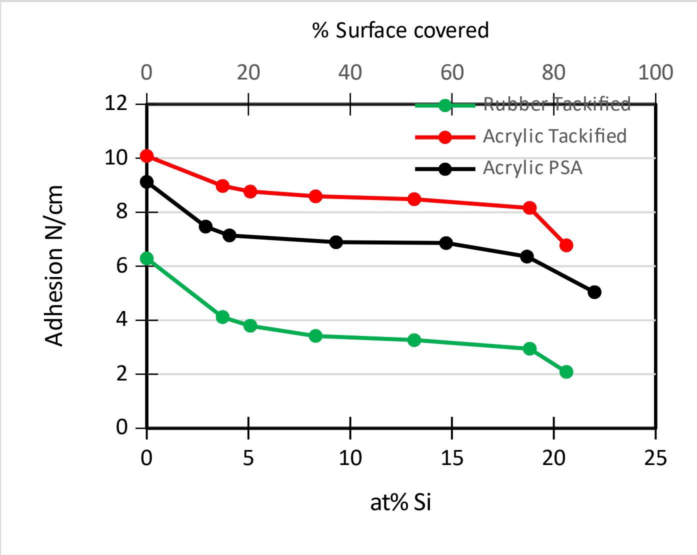
WHAT IS SILICONE MIGRATION? The silicone release coating is a very thin layer of an elastomeric silicone rubber on the surface of the release liner. The silicone needs to be applied as a liquid, before being crosslinked to form the final silicone elastomer. They can be applied as solvent dispersions, water-based emulsions, or (most commonly) as a mixture of silicone fluids referred to as 'solventless silicone coatings'. Regardless of the physical form they all need to be crosslinked to form the final silicone elastomer using heat or UV radiation.

The release coatings are designed such that all of the polymers will crosslink to form the final elastomeric coating, but there is always the risk that there might be a small proportion of unreacted silicone polymers present in the final release coating (either because they did not successfully react into the elastomer, or because they lack the functional groups which enable them to react into the silicone elastomer).

The presence of these unreacted silicone polymers in the final release coating means that there is a potential risk of them migrating beyond coating. Typically, such migration would initially be to the silicone surface and then from there, migration onto and into the material in contact with the silicone such as the Pressure Sensitive Adhesive (PSA), or the base substrate.

In order to better understand and characterize the level of silicone migration from a release liner and the subsequent impact this migration could have, a series of studies were completed under the leadership of IFAM (Fraunhofer Institute). Their initial evaluations on typical, well crosslinked, silicone release liners showed that for such 'well-crosslinked' release coatings[ref 1,2&3], only very low levels of silicone migration could be expected (equivalent to 5-10% of the contaminated surface covered). Only where level of crosslinking was demonstrably lower could there be more significant levels of contamination.

WHAT MIGHT BE THE IMPACT OF SILICONE MIGRATION? The impact of silicone migration on performance of other materials has historically been perceived as having two main types of effect: (a) **Reduction in adhesion performance on contaminated surfaces** (typically the adhesion of a Pressure Sensitive Adhesive (PSA) to a contaminated surface or contaminated PSA surface to another surface but could also be the adhesion of a coating/paint to a contaminated surface), and (b) **Interference with wetting behaviour of materials on the contaminated surface** (e.g. printing performance on a contaminated surface, or wetting of a coating).



ADHESION - In order to better understand and characterize this impact of silicone migration, the same series of studies under the leadership of IFAM, ran a series of practical evaluations[ref4,5],. These included measurements to correlate the level of silicone migration with the impact they could have on adhesive performance. The focus in this case was that of the automotive industry where the team wanted to characterize the scale of impact of silicone migration on adhesion of PSA's to contaminated car surfaces as well as adhesion of laquers and paints to car surfaces. Through controlled contamination of surfaces and adhesion testing, they were able to demonstrate that in order to significantly reduce adhesion performance on a car body it would require a very high level of silicone migration. This can be clearly seen from the following graph where a range of PSA's used in automotive applications were tested against silicone contaminated surfaces. The level of silicone contamination was determined using X-ray Photoelectron Spectroscopy (XPS), where the atomic% Si can be measured and converted into silicone coverage (x4, assuming all Si is present as silicone). After a small initial reduction in adhesion at very low levels of surface contamination, there is little impact of silicone contamination on adhesion until a very high level of surface coverage is reached (around 80% silicone surface coverage).

The impact of silicone contamination on adhesion of other materials was also studied. This included an evaluation of the adhesion of a water based lacquer used widely in the automotive industry, to a standard corrosion treated metal surface used to represent a car body (known as KTL-steel). Here the impact of silicone contamination was even weaker than for PSA adhesion, with even very high levels of silicone contamination showing no impact at all on the paint adhesion (as characterized by the automotive test method for paint adhesion).

WETTING - As a further step, the study also included evaluations on the impact of silicone migration on 'wetting' of materials (such as paints/lacquers and printing inks), to contaminated surfaces. This included evaluation of the coating performance of a water based automotive lacquer (same as had been used for adhesion testing), onto metal surfaces contaminated with silicone. The metal surface was a standard corrosion treated surface (KTL-steel), and the visible 'coating defects' were assessed in terms of number and size. The results showed that even at quite low levels of silicone contamination (>20% surface coverage), there was evidence of 'coating defects' for the most 'sensitive' lacquers, although at the very low levels of surface contamination (around 10%), there were no defects.

SUMMARY & CONCLUSIONS - Migration of silicone species from silicone release liner is always a possibility where the silicone coating is brought into contact with other surfaces. Even if completely crosslinked there is always the chance of some migration of silicone species. What this work has highlighted, though, is that under normal circumstances, with a well crosslinked release liner, such low levels of silicone migration should not be enough to have an impact on the subsequent performance of the materials involved. In terms of the impact on adhesion performance, only a very high level of silicone migration could have any significant

impact which could only occur where the release coating had not been sufficiently crosslinked. In terms of the impact on 'wetting' defects it was evident that silicone migration was more of a concern and showed an impact at much lower levels, but even here, provided that the level of crosslinking of the silicone release coating was sufficient, there should still not be any significant impact.

The overall conclusion is that provided the level of silicone crosslinking is sufficient (equivalent to a silicone 'extractables' level of less than 3%), there should be no significant impact on either 'adhesion or 'wetting' of materials that come into contact with the silicone release liners.

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