MICA in Glass Flake Coatings

MICA is commonly used as a filler to increase the permeation path thru a coating.

It is a crystal structure (muscovite (potassium mica) and phlogopite (magnesium mica) are the most common types used with phlogopite most common here in the northeast US). Since they crystalize in a monoclinic system they are layed out in sheets or scales (the 3 axis of the crystal are uneven so they tend to lay out in one direction forming sheets) .

As a result they form very fine platlettes in the ground forms we use in coatings.
Its flake shape allows for overlap/overlay. We had several products using MICA at one point and used it in our EE-96 rebuild but we found it's use provided less permeation resistance than our other products utilizing different types of fillers.

The decreased of permeation resistance we see in competitive products is evidenced by a general softness observed at the surface of the coating during inspection and is do to one of two factors or some combination of both;
a) excessive filling; common in many systems to reduce cost; in others a problem of 'a little is good more is better';
b) lack of or insufficient use of coupling agents. This is an area that those of us in the 'high performance' catagory differentiate ourselves from the commodity producers.

A mineral filler is inherently incompatable with an organic epoxy system. No covalent chemical bond will form between them so you will have so at best you can have very weak ionic bonding.
They actually act to repel each other (refered to as repulsive exchange forces) creating an internal stress wanting to essentially 'blow the system apart'. In this case weaker non-specific cohesive forces (van der Waals forces) keep the system together.
The chemical & physical nature of MICA vs. the epoxy is such that the cohesive forces of the systems are weaker than with many other fillers materials and the repulsive forces greater. As such the system is more prone to breakdown, hence the punkiness you have seen.
Use of coupling agents can help bond the filler and the resin system using an intermediary to bond to the resin and the filler. I discussed this regarding adhesion in an earlier e-mail;

> **For example adhesion of an epoxy (organic) to steel (inorganic) will have both a physical and a chemical attribute. On its own the chemical portion will be a simple weak hydrogen bond and to some extent the stronger ionic bond. The addition of a dual reactive molecule will promote a much stronger covalent bond. It works much like soap. One side of the molecule has a reactive group that will for a bond with the steel (inorganics). The other side offers up an organic reactive group which will bond with the epoxide group (much like the amine hydrogen) giving a much stronger covalent bond.**

Use of coupling (cohesive) agents is essential the same as adhesion promoters the difference being the coupling agent is within the system & the adhesion promoter is between different systems (epoxy & substrate).
The best types for use with fillers are reactive functional copolymers especially the maleated polymers. We also use surfactants and other non-reactive polar copolymers. We would adjusting the balance between them for different filler types & loadings and for the intended use of the product.
MICA has some inherent difficulties particularly associated with its flake structure.