I covered the subject of dirt in JCT CoatingsTech in August 2005 ([2 (19) 52 (2005)]). However, dirt and dirt problems never go away and I recently was asked to do some dirt consulting, so I am revisiting the subject. Many readers may not think of dirt as a surface defect, but it really is the most common defect of all. Dirt in or on a coated surface mars the appearance, often necessitates repainting, and can lead to customer complaints and claims. Dirt has been known to contribute to cratering. Kinds of dirt that show up on or in paint films include fibers (such as the one in Figure 1), paint chips and flakes, sanding dust, weld balls and weld spatter, metal fines, oven dirt (condensate and carbonized resin), resin gel particles, and pigment agglomerates (often called seeds). There are other defects that resemble dirt such as paint drops, gun spits, and overspray. Substrate defects, solvent pops, trapped air, and substrate gassing may be mistaken for dirt.

The techniques used to characterize and identify dirt include optical, infrared, and electron microscopy and many analytical methods, particularly IR spectroscopy. Since dirt that is covered with paint is difficult to see, much less identify, cross sectioning of the panel or part often is necessary to allow a good view of the material (see Figure 2). Sometimes the paint layer over the dirt can be removed by careful sanding with fine paper or scraping with a scalpel. Some investigators have become quite adept at removing dirt particles from defects so that they can better analyze the material under a microscope or in an IR spectrometer, yet do not have to destroy the part. It is important to document dirt that has been characterized as well with known dirt specimens by saving photomicrographs and analytical results on a computer to form a “dirt library.” Software is available that allows split screen comparisons of images of unknown dirt with those in the “library” to see whether the new dirt really is new or is a known material.

The paint usually is blamed for dirt problems, but rarely is the culprit. Most dirt comes from the paint user’s plant, process, and/or workers. However, it can come from the paint and manufacturers should take great care to prevent dirt or anything that resembles dirt from getting into or forming in the paint. Clean raw materials are essential. Good housekeeping in the paint plant is required, and equipment such as tanks, mills, pipes, pumps, and hoses must be kept clean. If possible, equipment should be dedicated to specific technologies (particularly important for waterborne and solventborne). Tanks must be covered. Environmental air must be kept clean via a system of air filters that are inspected and changed on a regular basis. Resin production and handling must be controlled to minimize formation of gel particles. The leardown process must be properly controlled to prevent pigment shock. Filtration, particularly during filling, is critical and containers being filled also must be clean. The paint must be filtered again before it is loaded into the customer’s system.

The paint user must have a clean paint shop or other area where paint is applied. Ideally, a paint shop will be separated from the rest of a manufacturing plant. Plant environmental air and compressed air for spray application must be clean and filters must be changed and their effectiveness checked periodically; paint lines must be protected by filtration and booths and ovens need to be cleaned regularly; workers must be well trained and disciplined; low lint protective clothing and wiping cloths are required. Keep everyone but the painters out of booths and other painting areas. Better yet, keep painters out and use automatic application equipment, such as robots, reciprocating guns, or bells wherever economics allow. There is an axiom often quoted by dirt specialists that “people equal dirt.” Dirt audits are useful for identifying work practices, equipment, and processes that contribute to dirt problems and to establish baselines so that subsequent surveys can determine whether dirt levels have been reduced or not. This is true for both paint plants and paint shops. An audit involves close inspection of the plant or paint shop using a checklist to make sure that nothing is missed and taking detailed notes on possible dirt sources. Knowledge of what kinds of dirt have been found on painted ware can help in the search for sources.