Phenolic resins as Binders for Bonded Abrasives……holding it all together.

Paul Ashford, Anthesis-Caleb.

Regulatory and Sustainability advisors to the European Phenolic Resins Association (EPRA)

Phenolic resins, the ultimate binder….?

It will come as no surprise that formaldehyde has been at the forefront of regulatory attention since notification of the intent to reclassify the substance as a Category 1B carcinogen in 2012, followed by entry into force in 2016. However, as regulators have studied the implications of this decision, they have come to realise that most formaldehyde is used as a monomer in the production of polymers.

Phenolic polymers have the critical advantage that the phenol-formaldehyde reaction is non-reversible and that formaldehyde emissions from the final product are highly unlikely as a result. Therefore, if those emissions can be controlled during the manufacturing stages of the resin and downstream products, the final articles themselves will have no adverse effects.

In a consultation conducted by the French Competent Authority (ANSES) in 2016, the Bonded Abrasives industry, represented by the Federation of European Producers of Abrasives (FEPA) became vocal on this point. They wanted to highlight in their submission the absolute value of phenolic polymers as a binder for many grinding wheels (pictured above), cutting discs and other similar products. Phenolic resins are also used extensively as binders in coated abrasives such as sandpapers, emery cloth, abrasive belts, flap wheels and flap discs.

It is interesting that for a number of applications no other binders currently offer the same strength, temperature resistance, lack of ageing and lack of thermo-plasticity that phenolics achieve. FEPA wanted to publicly acknowledge that these properties are necessary to meet the strength requirements and validity dates stipulated in the European Safety Standards for abrasives (EN standards**) to protect end-users from potential accidents. The Industry emphasized that any compromise on the above properties could lead to unintended consequences for professional and consumer safety when using their products. The implications of shattering wheels and discs were all too obvious.

Moving to lower free formaldehyde systems…

While confident of the inert character of its final products, the Bonded Abrasives producers wanted to work with their suppliers (including EPRA members) to limit formaldehyde exposures for their workforces to the maximum possible extent. This led to the development and introduction of a range of low free formaldehyde resins which were trialed within the industry in order to establish their viability. The importance of consistency and reproducibility in the Bonded Abrasives sector is paramount and FEPA members were careful to ensure that these new resins were compatible with their existing processes or, at least, could be optimized to be so.

The results have been highly encouraging and the overall transition to low free formaldehyde resins has been a success, even though there are some specialist applications which continue to need resins with higher formaldehyde contents. The success has been in no small part due to work that has also gone on amongst the resins producers themselves.

Measuring free formaldehyde at low levels…

The issue that was facing EPRA members was that there were no commonly agreed methods for measuring free formaldehyde levels in resins at less than 0.1% by weight. Therefore, the challenge was to introduce such a method across the industry to provide confidence to downstream users such as the Bonded Abrasives industry.

Through the careful selection of appropriate analytical techniques and the sharing of those techniques across the industry, EPRA members were able to build-up a clear level of confidence in the reproducibility of such tests. This was substantiated by a series of round-robin tests on various resin types. The method is based on UNI EN ISO 11402 and is capable of measuring down to 0.03%.

Although cause and effect are always difficult to prove, the consistency of manufacture of low free formaldehyde resins resulting from this work is likely to have contributed significantly to the smoothness of the transition achieved in the Bonded Abrasives sector.

Growing supply-chain cooperation…

The European abrasive industry significantly impacts productivity in most other industrial and service sectors, including steel, metal processing, construction, automobile manufacturing, space, glass, electronic, energy, "green" industries… It is thus important that FEPA speaks up as an Association when new regulatory measures could result in regrettable substitutions and consequently endanger the end-user or limit the innovation in downstream industries. This is especially relevant considering workers are already protected by appropriate occupational safety measures.

However, the sense of shared adversity created by the regulatory challenge has spawned a level of cooperation within the supply chain that is likely to be maintained and enhanced over time. Such cooperation is one of the intended consequences anticipated under REACH and this perhaps represents a good case study.

It should be noted that resin-bonded abrasives and coated abrasives only represent two of five product types used in the abrasives sector (vitrified abrasives, super abrasives/metal bonded abrasives and free grains being the other three). Nevertheless, since these various technologies are broadly complementary to each other, the maintenance of the resinous sector remains an important goal for FEPA members.

For the phenolic resins industry, a focus on the rationale for the selection of phenolic resins has highlighted the characteristics that have often been taken for granted in the past and which underpin the on-going growth trends across the phenolic industry.

** EN Safety Standards: EN 12413 (Bonded Abrasives), EN 13236 (Superabrasives), EN 13743 (Coated Abrasives)