Impact of Regulations on Printing Inks

By Anthony Bean

We are all aware that the world of regulations continues to grow and tighten on businesses around the world. Regulations in and of themselves are not bad and in many situations are required to protect and correct. The impact of regulations can be both negative and positive, even with good laws. Regulations should not be stopped, but as an industry we need to educate those who generate these restrictions on our businesses.

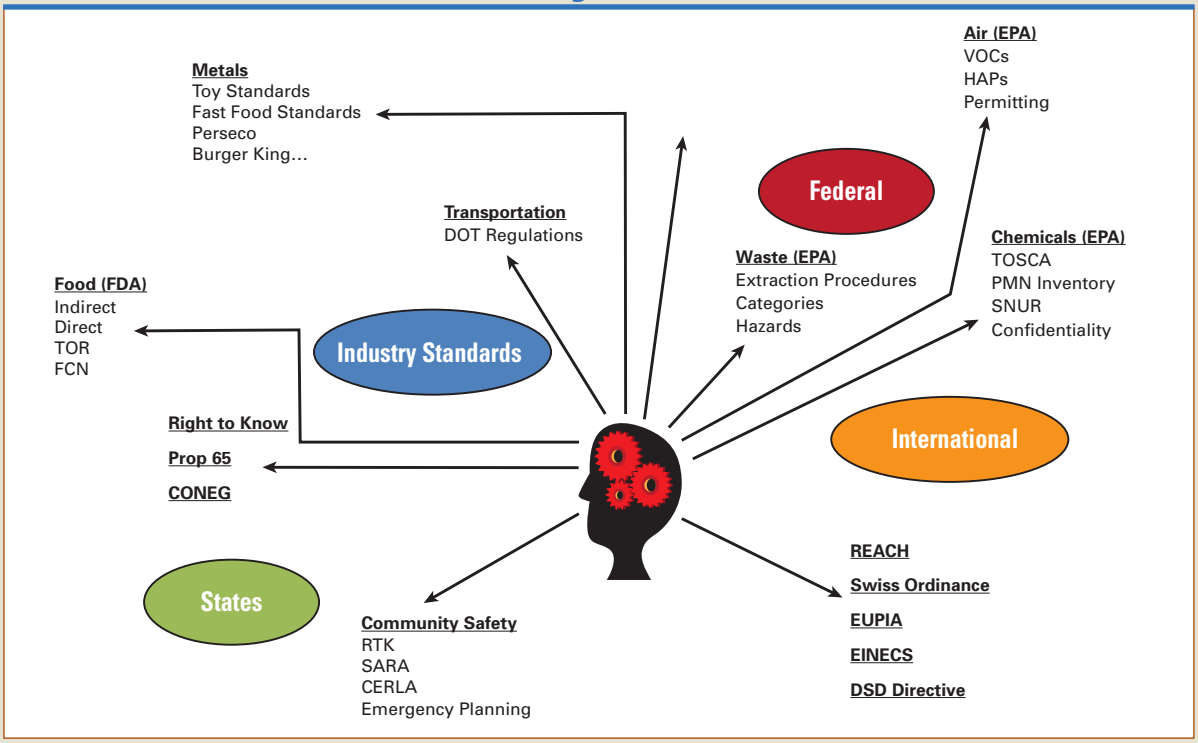
As a chemist and ink/coating formulator, I am reminded of Clint Eastwood's movie "The Good, the Bad and the Ugly." It's an apt description of the ink situation.

The good—as environmentalists and toxicologists learn more about the impact of chemicals, it is good that they raise a flag to warn of possible dangers. Even though items may have been in use for many years, new data may require that certain practices or uses be terminated.

The bad—unfortunately, some regulators feel the need to protect everyone against all potential risks without adequate knowledge of the science or proper risk analysis. We have all seen the insignia on five-gallon

Figure 1

Restrictions for formulators around the globe



containers that show a child falling into a bucket, but is this truly necessary for or effective at preventing accidental drowning in a bucket?

The ugly—laws such as Proposition 65 (Prop 65), which requires a label on anything containing a known carcinogen, regardless of amount.[1] Some items of note are acetaldehyde used in yogurt for flavor; pyridine found in chocolate; ethyl alcohol found in various beverages; and various compounds found in mother's milk. Certainly, if unsafe levels are contained in a product, proper notification should be the minimal response. However, labeling everything without regard to potential risk desensitizes people to real dangers eventually ignored as just one more panic. Remember the story of "Chicken Little" or "The Boy Who Cried Wolf"?

Keeping up with the various laws is certainly becoming a more significant task than it once was, and formulators must keep in mind the various restrictions. Local, state and federal regulations are just part of the overall burden on ink makers, as well as consumer product organizations, industry groups and large companies that often have their own demands that must be met in order to supply their market (Figure 1). As we become a more global economy, the regulations of other countries must also be taken into account, and compliance to those demands adds to the complexity. The playing field is not often uniform because some items may be acceptable in one area but not another. Whereas the content of heavy metals is a fairly uniform restriction, printing on tobacco packaging requires that the inks be free of urethanes and fluorinated slip agents. These items are not an issue for most other packaging applications and even direct food contact.

In addition to all these various regulations and organizations, the growth of acronyms has similarly multiplied. Often an obvious acronym is not the one you thought it was. There should be a college course in deciphering these. Something as simple as "AA" has 294 definitions, according to *Acronymfinder.com*. Twenty-two have to do with information technology, 50 with business, 63 with science and government leads the way with 76 definitions. Do we all know what EPA stands for? There are 80 definitions that *acronymfinder.com* recognizes. VOC (volatile organic compounds) only has 41 definitions, but I know a few that are not listed.

Given all the constraints, the ink industry is like many other businesses in that as we move to comply with regulations—while still satisfying customer requirements—the process is not always easy or economical. For UV curing, the tale of photoinitiator changes is an interesting one that continues to evolve. The first commercial UV inks run in 1969 used Aroclor 1260 as a photoinitiator. It was a low-cost, effective, non-yellowing material that also imparted great flexibility, gloss and adhesion. If you Google the material, it comes up as polychlorinated biphenyl, pure PCB, which, by the way, has 64 definitions. The rightful concerns about PCBs quickly led to the replacement of the material. Michler's Ketone (MK) was discovered as a photoinitiator and the fledgling industry quickly moved to it. But, after evaluation of the health attributes of MK, it was removed due to concerns about impurities and as a potential human carcinogen.

The industry expanded the use of other materials such as benzophenone, which was added to the Prop 65 list in June 2012. Benzophenone in food packaging had been removed by most responsible formulators due to the migratory properties of the material and the significant impact on organoleptic qualities, but it does remain in non-sensitive applications due to its relative low cost, initiation effectiveness and other interesting properties.

Due to the fact that photoinitiators are small molecules and typically do not take part in the polymerization of free-radical curing, these materials continue to come under regulatory scrutiny and are the continuing subject of studies regarding their migratory nature in food packaging. This is driving the use of polymeric photoinitiators that increase the molecular size and reduce migration possibilities. It also makes electron beam (EB) suppliers smile since EB curing does not require these materials.

It is impossible to touch upon all the regulatory issues and their impact on the wide variety of ink technologies. There are some items that are common to all inks (solvent-based, water-based or oil-based) and that is pigments. Many of the commonly used pigments

TABLE 1

Unwanted trace contaminants found in various pigments within specific color groups

Color	Color Index Name	Concerns*
Yellow	Y12, Y13,Y14,Y17,Y83	DCB, PCBs, DMB, Aromatic amine
Orange	05,034,046	Barium, DCB, PCBs, Prop 65, Sara 313
Reds	R2,R38, R48, R49, R53, R60, R112, R169	Barium, DCB, PCBs, SARA 313, Prop 65
Blue	B15	Copper, PCBs, Molybdenum
Violets	V23, V27	Dioxins, o-Dichlorobenzene, Cyanide, Sara 313
Greens	G7, G36	Copper, PCBs, HCB, Chlorine, Bromine
Black	PB7	PNAs, PAHs

*Note that concerns are not for every pigment listed but is cumulative for the color group.

do contain trace amounts of items listed on Prop 65, including metals and other unwanted chemicals. This can cause some issues with customers who do not understand the various laws and Comprehensive Procurement Guidelines (CPG) requirements.[2] Complicating this is less than forthright suppliers who make statements that their inks do not contain any of the undesirable materials. In conversations with some large companies at the forefront of CPG requirements, they recognize that these items exist and although they would like to eliminate them, they also recognize the necessity and reality of continued use for the near term.

Without specification of amounts, Table 1 shows some of the unwanted trace contaminants that may be found in various pigments within the specific color groups. In most cases, the items are not available for migration but can be found when the pigment is digested with appropriate chemicals and the material is released. Sophisticated analytic techniques are needed to identify the small amounts of material. Is the material in the pigment? Yes. Is it readily available to cause a problem? No. Unfortunately, some people do not understand the difference. All of the colorants listed in Table 1 are key color groups used in producing printing inks. Although in some cases the materials may be able to be removed, the process would make the colorants not economical. In other cases, it is not possible because the element may be critical to the chromophore.

If we look at a typical palette of colors that allow for the printing of various graphics, there are typically 12 to 13 colors, although more can certainly be found where special colors are needed. Using the chosen colors, one can generate a color gamut (Figure 2). The color gamut is all the possible colors which can be produced through blending the chosen individual colors.

Generally, it is advantageous to have as large a color gamut as possible so that a printer can try to capture the vision the graphic designers would like

FIGURE 2

Packaging ink gamut

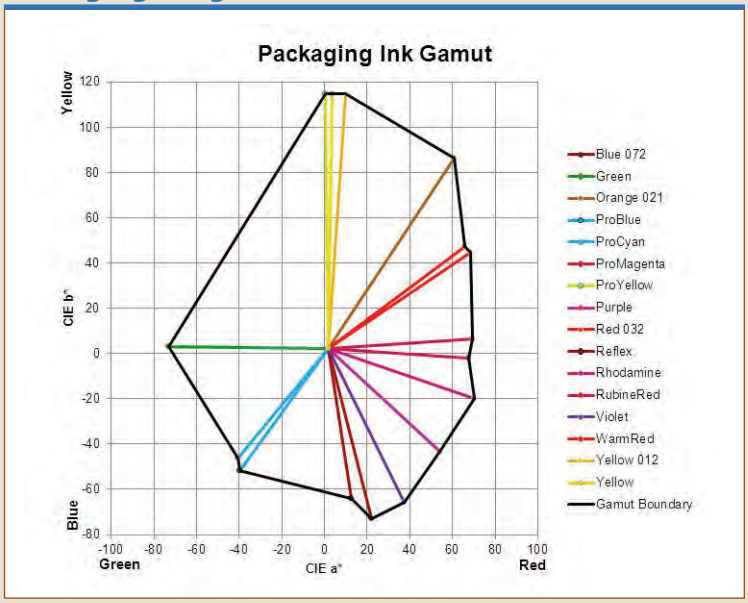
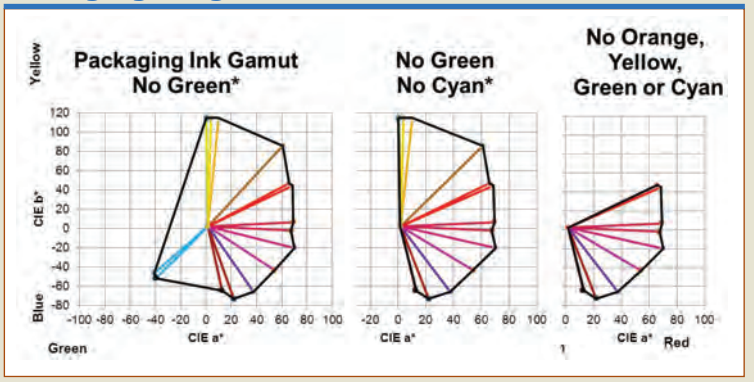


FIGURE 3

Packaging ink gamut shrinks as inks are eliminated



to have converted to the final package, catalog or advertisement. The need to minimize or, if possible, eliminate materials that are a concern is a real goal that pigment suppliers strive to achieve. In many cases there are alternatives that will give a similar color but, with the change, other attributes may suffer. Most obviously, cost will increase significantly. If the goal could be obtained currently without this impact, the industry would move in that direction. Besides costs, other attributes that may be impacted are hue, transparency, fastness properties and dispersion. Looking at the color gamut, one can quickly visualize the shrinking color space as various colors are eliminated (Figure 3).

Continue the process and eliminate the black and a few more colors and the resulting color space is nonexistent. The current shelves of our stores are vibrant with color although often mind boggling when trying to find a particular item. Try to imagine current packaging, magazines and containers without the vivid colors that are currently available. Picture the grocery aisle with every container being all white or with faint penciled "Corn Flakes" written on it, or everything in basic light brown. Can the shopper determine what is in the package by the shape of the box, the weight or the sound as they shake it?

The regulations around the world continue to increase. Most often, it is for good reason, to protect workers handling the materials or consumers using the product. Given this fact, we must be sure that our regulators understand the risk that various chemicals pose, but balance that with the impact to the market. It is up to all the various industries to try to police themselves to prevent overreaction and the introduction of unrealistic regulations that end up negatively impacting all of us.

What products would look like without inks.

Vibrant colored packaging inks help entice consumers.

References

1. Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986, was enacted as a ballot initiative in November 1986. The Proposition was intended by its authors to protect California citizens and the State's drinking water sources from chemicals known to cause cancer, birth defects or other reproductive harm, and to inform citizens about exposures to such chemicals. Proposition 65 requires the governor to publish, at least annually, a list of chemicals known to the state to cause cancer or reproductive toxicity.
2. The Comprehensive Procurement Guideline (CPG) program is part of EPA's continuing effort to promote the use of materials recovered from solid waste. Buying recycled-content products ensures that the materials collected in recycling programs will be used again in the manufacture of new products.

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