

Elimination Of Organic Solvents In Aluminium Pigment Production

In recent years a lot of emphasis has been put on the importance of low VOC coatings, low CO₂ emissions and the methods and processes to achieve these goals. What is often missed from the equation are the up stream processes used to get us to this end stage and whether they are also low VOC/ low CO₂ emitting processes. There is little point in having a green water based paint if it has been made from a very ungreen set of raw materials. The really important question that we should be asking is: what is the VOC and CO₂ footprint of the finished coating not what is the VOC content of the paint itself?

Potted History Of Aluminium Pigment Production

Metallic pigment production was pioneered back in the late 1840's by Henry Bessemer the famous steel maker and later in the 1920's Hall invented the first solvent-based wet ball milling process. To this day the basic process of aluminium pigment production has not changed significantly and still over 90% of all aluminium pigment production is carried out in large scale wet ball mills utilising atomised aluminium powder and large volumes of white spirit. This batch processing is energy intensive, labour intensive, costly and most importantly it requires large volumes of solvent both in the milling stage and during the secondary screening and classifying of the flakes.

CO₂ And VOC Emissions

The conventional solvent based milling techniques for aluminium flake involve large volumes of mineral spirits both to mill the aluminium powder into the thin flake and also to reduce the viscosity of the system so that the aluminium slurries can then be passed over very fine screens to produce the various size fractions required by the market. All the solvents used in these processes then have to be re-distilled back to clean spirit to start the cycle again for the next batch. This process of recovery and distillation requires large quantities of energy and invariably emits a few percent of spirit to atmosphere.

The next step is the complicated and costly process of removing the mineral spirits from the filtercake (a filtered mix of 60% aluminium flakes and around 40% solvent) and exchanging this for water or a water miscible solvent to render the cake suitable for waterborne coatings system. Once the aluminium cake has been converted from a solvent carried aluminium cake to a water carried aluminium cake via solvent exchange there is then a large waste stream of solvent water mixtures that have to be disposed of or separated out by fractional distillation.

The Water Based Aluminium Production Process

In recent years Metaflake Ltd has pioneered a process whereby all the conventional approaches and assumptions concerning aluminium pigment production have been discarded.

This new age processing approach relies exclusively on the combination of aluminium powder, water and a proprietary passivator/lubricant to resist the reaction between aluminium and water and also to lubricate the milling process. In addition, **the processing is carried out in a continuous manner**, to deliver a highly consistent milled flake with exceptional metallic finish and lustre.

The important and valuable environmental improvements of this water-based process are:

- A. Zero VOC emissions during the manufacture and subsequent production process ,
- B. Low CO₂ footprint due to the elimination of the need for:
 - 1. The energy intensive and costly distillation and recovery process
 - 2. -The conversion from a solvent to a water-based carrier and the resultant waste streams and disposal costs
 - 3. -Transportation of solvents and waste products across the country

Water milling does produce waste water. However this can either be reused in the next milling cycle or when necessary it can be separated back into water and lubricant using flocculating additives which requires virtually no energy input.

Quality Of Water Milled Aluminium

In the past, attempts at water milled products manufactured in conventional tumbler ball mills resulted in rather mixed quality products that were characterised by mediocre metallic finishes. This was largely to do with poor lubrication between water, lubricant and aluminium, and partly to do with the ongoing corrosion reaction between aluminium and water. The corrosion reaction during milling produces abrasive oxides and hydroxides which interfere with the highly critical polishing action of the mill and consequently produce a poor metallic lustre on the flake surface.

Metaflake's new approach means that water milling aluminums as fine as 5um to as coarse as 1mm can be produce flake with absolutely no loss of specular reflectance.

The interesting range, from a coating point of view, is flakes from 5um up to 50um. In this range Metaflake's water milling approach can deliver a super bright smooth and highly reflective flake. Such flakes are as bright as conventionally milled aluminium's and under selected conditions can possess unsurpassed reflectance and coverage. These super bright silver dollars are ideal for formulations where a low VOC is required and a highly reflective finish is desired

A significant problem with aluminium pigment produced in solvent is that they have a resultant fatty acid coating and are never keen to be placed into an aqueous hydrophilic system.

Aluminium flake produced in water however is very keen to mix with water based coating systems. This important property furthermore gives excellent compatibility and lie down in water based coatings.

The stability of water based aluminium paints is also an area of importance as aluminium can react with water to liberate hydrogen. To achieve stability, the addition of passivation chemicals is always necessary in pigments milled in organic solvent.

Aluminium flakes milled in water have the advantage that they are inherently more stable in water than solvent milled products. This is because they possess a thicker oxide/hydroxide layer, the result of which is that they can be passivated with much lower levels of chemical treatment and in some cases require no chemical treatment at all. This reduction in the requirement to add passivation chemicals further improves the green credentials of Metaflake's water milled flakes over conventional solvent milled products.

Cost Reduction Of A Green Process

Too often we find that a more green process results in higher production costs which results in a more expensive product for the consumer. This is *not* the case with the new water based process as a result of the following factors:

There are no set up solvent costs, no costly storage and handling costs, no costly flame resistant motors buildings and zoned areas, Transport cost are lower due to vastly reduced raw material requirements. There is no costly batch processing and finally manning costs are low due to zero flammability risk. All these factors lead to a much lower cost end product and this advantage can be passed onto the customer.

Conclusion

Metaflake has developed a totally new process for aluminium pigment production, which has gone against all conventional thinking about aluminium and water, and the processes of making aluminium flakes. The new aluminium pigment process should soon consign conventional solvent-based aluminium pigment production to the history books along with the dinosaurs. If companies are really going to talk about being green then they have to look carefully at the source of their raw materials not just the green credentials of their finished product. Right from the start of the supply chain to the finished article, the questions they should be asking are:

- Are your suppliers truly green?
- What is the VOC and carbon foot print of your suppliers?
- How much effort are you putting in to develop a truly green process and how much is simply just having the right paperwork?

