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Our Ref: 24/OMATTHEWS/GC01/GET

7th July 2024

Oliver Matthews,
Environmental Compliance Ltd.,
Unit G1,
Th Willowford,
Treforest Industrial Estate,
Pontypridd,
CF37 5BF.

Dear Mr Matthews,

Re. Your Proof of Evidence (Rebuttal/Formaldehyde) II of July 2024

I write regarding your above referenced document relating to:

ENVIRONMENTAL PERMIT APPEAL
REF: CAS-02313-Z1D6V4
APPEAL BY: PLATTS AGRICULTURE LIMITED
SITE AT: LLAY INDUSTRIAL ESTATE, NORTH, LLAY, WREXHAM, LL12 0PJ

I confirm that I concur with your comments and arguments regarding the detection and assaying of formaldehyde as presented in paragraphs 2.14 to 2.20 and 5.1 of your above referenced document.

In my expert professional opinion:

The chromotropic acid-based assay for formaldehyde, while effective in ideal circumstances, suffers a number of issues in more complex circumstances, for example when samples are mixtures of materials, such as extracts of wood-based products. This assay for formaldehyde is commonly available and quite sensitive, the reaction between formaldehyde and chromotropic acid generating a purple colouration proportional to the

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concentration of formaldehyde present. This colouration is typically quantified using a spectrophotometer. However, the assay is primarily intended for relatively simple solutions of formaldehyde in aqueous media and suffers a number of issues that can distort results otherwise. Issues include, but are not limited to:

1. As well as formaldehyde, chromotropic acid also reacts with various other compounds and species, including nitrate and phenol; indeed, it is also used as an assay for nitrate levels. The assay for formaldehyde is therefore prone to interference and false positives from other chemical species present.

2. The assay is performed in highly acidic conditions, this can affect other substances deriving from the sample, again leading to confounding effects, particularly if the decomposition products of acid attack are reactive towards chromotropic acid or actually yield formaldehyde.

3. As the assay directly relies on a chemical reaction, careful control of conditions and timing is required for accurate results.

4. The assay measures the degree of colouration, typically using a spectrophotometer. While accurate for optically clear assay solutions (within the instrumental capabilities), the determination is acutely inaccurate for cloudy and/or scattering assay solutions. It may be noted that filtration to remove such interfering particulates can in its own right lead to further issues with impurities; centrifugation it usually preferable.

5. Similarly, the effect of other coloured species present in the assay solution, perhaps from inherently coloured components of the sample, require careful control and consideration if not to distort apparent measured formaldehyde levels.

Beyond these issues with the assay methodology itself, there are issues specific to wood-based products. Firstly, wood-based products are very complex chemically and contain a milieu of chemical species that can interfere with and confound assays. Moreover, it is well documented that formaldehyde levels rise on heating wood, as the carbohydrate components degrade, generating formaldehyde beyond that initially present. It is therefore important to realise that the extraction method on analysing wood-based materials will inevitably give apparently elevated levels of formaldehyde if heating is involved. Even moderate levels of heating, such as to 50°C, are documented as increasing formaldehyde levels.

One common method of extraction is the “perforator” method, which involves heating wood with boiling toluene. Such extraction methods, although common, can give apparent

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formaldehyde levels many-fold higher than that actually present at ambient temperature. Ambient temperature water extraction has been documented as capable of extracting formaldehyde from wood without heating, giving efficient recovery of the true formaldehyde content; in my opinion this extraction method is optimal.

MDF board and other preformed wood-based products can use formaldehyde-urea type adhesives to bond particles together. While the adhesive is described as "formaldehyde-urea", these are the two reagents used to form the adhesive; once reacted together the formaldehyde is consumed to form the adhesive. Decomposition of formaldehyde-urea adhesive typically doesn't revert back to formaldehyde and urea as separate species, instead other decomposition species are formed, such as carbon dioxide and ammonia. These decomposition products can interfere with chromotropic acid-based assays.

In principle excess formaldehyde can be present at the time of board manufacture, either by design or imperfect stoichiometry of the adhesive formation. However, formaldehyde is a readily volatile substance and such excess would be expected to rapidly diminish after board production and is routinely tested for as part of board specifications.

Yours sincerely,

George Tranter
Fellow of the Royal Society of Chemistry
Chartered Chemist
Chartered Scientist of Europe

I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

I understand that proceedings for contempt of court may be brought against anyone who makes, or causes to be made, a false statement in a document verified by a statement of truth without an honest belief in its truth.