KEIM Mineral Paints – Technical Digest

KEIM Ecosil-ME, Tackling Indoor Air Quality Issues

1. The Issue

Outdoor air pollution is a well-publicised discussion topic, focusing on industrial and transport emissions. It is really important, however, to also look at the potential health effects of poor indoor air quality. Indoor air quality can have negative impacts on building occupants, particularly for groups of people with specific sensitivity to pollution including the young, elderly and those who suffer with existing respiratory health conditions.

The impact of air pollutants on human health depends on their toxicity, concentration and exposure period, but with research suggesting that, on average, people spend 90% of their times indoors, the effects can range from odour, to irritation, to more serious toxic effects. In working and learning environments such as offices and schools, poor indoor air quality can significantly impact productivity and impair learning.

Indoor air pollution is created by a mixture of pollutants generated from inside the building and external pollution which migrates indoors. Internal sources include building materials used during construction, paints, furniture and furnishings, cleaning products and air fresheners, as well cooking and heating appliances. Technological equipment such as computers, fax machines, printers and photocopiers all produce small quantities of toxic air pollutants.

Examples of some of the most prevalent and potentially harmful indoor air pollutants include benzene, Volatile Organic Compounds (VOCs) such as toulene and ozone, formaldehyde, acetaldehyde and nitrogen dioxides.

Benzene

Benzene is present in both internal and external air, but is typically present in higher concentrations indoors, which is the primary source of human exposure to the chemical. Benzene is a genotoxic carcinogen, meaning that it has the capability to mutate the genes within a cell which can lead to cancer developing. There is no safe level of exposure which is recommended meaning that it is essential that, wherever possible, indoor levels are minimised and sources of the chemical removed. Human activities which produce benzene include tobacco smoke, solvents such as glues, paints, furniture wax, and detergents as well as some building materials.

VOCs

VOCs such as toluene are organic chemicals that have a high vapour pressure at ordinary room temperature. Their high vapour pressure causes large numbers of molecules to evaporate from the liquid or solid form of the compound and enter the surrounding air. VOC is a generic term which can describe many chemicals including benzene and formaldehyde which are discussed separately in this document.

Toluene is added to petrol and used as a solvent. Toluene primarily attacks the central nervous system (CNS) and symptoms frequently observed in humans acutely exposed to elevated airborne levels include fatigue, sleepiness, headaches, and nausea. Chronic inhalation exposure can cause irritation of the upper respiratory tract and eyes, sore throat and dizziness. Some studies have reported developmental effects,

such as CNS dysfunction, attention deficits, and minor craniofacial and limb anomalies in the children of pregnant women exposed to high levels of toluene or mixed solvents by inhalation.

Some research has also suggested that as well as being a respiratory irritant, VOCs also react with ozone (an outdoor pollutant known to cause respiratory inflammation produced indoors but some printers) to produce other toxic compounds.

Formaldehyde

Formaldehyde is a colourless, flammable, strong-smelling chemical that is used in building materials and to produce many household products. It is used in foam insulation materials, pressed-wood products, such as particleboard, plywood, and fibreboard; glues and adhesives; permanent-press fabrics and paper product coatings. In addition, formaldehyde is commonly used as an industrial fungicide, germicide, and disinfectant, and as a preservative in mortuaries and medical laboratories. Formaldehyde also occurs naturally in the environment. It is produced in small amounts by most living organisms as part of the normal metabolic processes.

When exposed to formaldehyde, some individuals may experience various short-term effects whilst some individuals may experience adverse effects such as watery eyes; burning sensations in the eyes, nose, and throat; coughing; wheezing; nausea; and skin irritation. Formaldehyde has been classified as a known human carcinogen (cancer-causing substance) by the International Agency for Research on Cancer and as a probable human carcinogen by the U.S. Environmental Protection Agency. Research studies of workers exposed to formaldehyde have suggested an association between formaldehyde exposure and several cancers, including nasopharyngeal cancer and leukaemia.

Acetaldehyde

Acetaldehyde is used to produce acetic acid and a variety of important related chemicals. The main sources of acetaldehyde are industrial plants producing or using it. It is also released from combustion processes and small amounts are found in tobacco smoke. Short-term exposure to acetaldehyde results in effects including irritation of the eyes, skin, and respiratory tract whereas long-term/high level exposure can cause respiratory tract irritation, central nervous system depression and possibly pulmonary oedema. Very high concentrations can cause dizziness, respiratory depression, convulsions or even death. Acetaldehyde is considered a probable human carcinogen based on animal studies.

Nitrogen Dioxide (NO_2)

Nitrogen dioxide exists, both indoors and outdoors in a gaseous form making inhalation is its major source of exposure to humans. Most NO_2 exposure occurs in the home from sources such as gas cookers and outdoors from industrial and transport emissions. Exposure to NO_2 can cause asthmatics significant inflammation of the airways, leading to reduced lung function growth and symptoms of bronchitis in asthmatic children. Moreover, nitrogen oxides (NO_x) are precursors of ozone. Although ozone acts as a protective layer in our atmosphere by absorbing UV radiation, excessive levels of this gas near ground level and indoors can cause breathing problems, asthma, lung diseases and reduced lung function.

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Whilst this is not an exhaustive list of the pollutants found in the air we breathe, it does highlight the potential harmful effects of some of the pollutants. The toxic cocktail of indoor air pollutants should be tackled using all available sources which can include the use of mineral paints discussed in section 2.

2. The Solution

Whilst measures can be taken to control outdoor emissions and ventilate internal areas, it is also possible to use materials such as mineral paints which are made with only natural materials to help improve internal air quality. Mineral paints are low VOC, do not contain any additional solvents and are both environmentally friendly and sustainable. Mineral paints are odourless and since they do not off-gas any chemicals, rooms can be occupied very quickly, as soon as the paint is dry without being a danger to health.

Keim Ecosil-ME is a particularly beneficial paint as it is a photocatalytic interior paint (ME = Minox Effect). Photocatalytic paints contain a catalyst, in this case titanium dioxide, which when activated by light, enables a reaction converting harmful air pollutants into harmless substances. The pollutants which Keim Ecosil-ME helps to reduce include all of those which have been identified in section 1.

The photocatalytic reaction also inhibits and kills bacteria. Independently tested it is proven to reduce living bacteria by 99% and dead cells completely. With regards to sanitation and health care the reduction and removal of dead and living biomass is very important to prevent infections. Dead cells can still have a toxic and allergic potential and Keim Ecosil-ME is proven to improve interior hygiene more effectively than a conventional film forming paint.

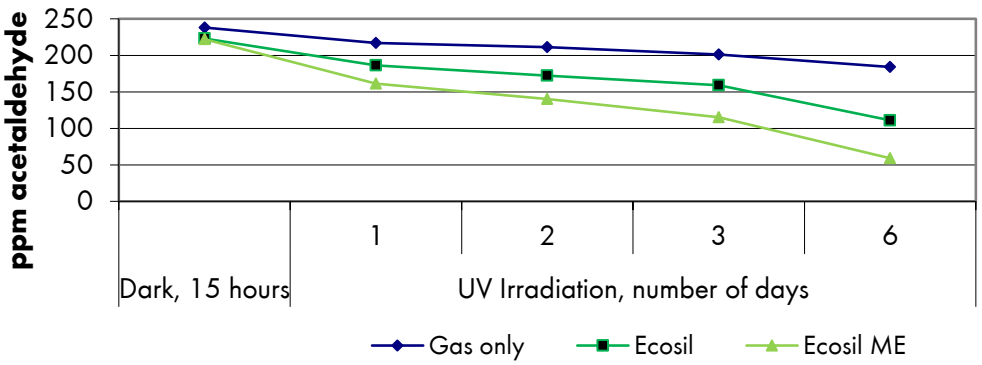
Keim Ecosil-ME offers all the features and benefits of Keim Mineral interior paints:

- High breathability (moisture vapour permeable) for dry walls and healthy room climate
- Non-combustible
- No toxic gases in the case of fire
- No solvents or plasticisers added, therefore no pollutant emissions
- Proven suitability for people with allergies
- Resistant to mould and fungal growth due to natural alkalinity
- Excellent ecological profile
- Mineral matt surface appearance
- Increases light reflectivity
- Lightfast and UV stable – no fading of colours
- Class 1 wet abrasion resistance

3. The Results

Photocatalytic activity evaluation result - Glass plates coated with photocatalytic TiO_2

Samples	**Acetaldehyde gas (ppm)** - Initial gas concentration: 250 ppm				
	Dark	**UV Irradiation (day)**			
	15 hrs	1	2	3	6
Gas Only	238	217	211	201	184
Keim Ecosil	223	186	172	159	111
Keim Ecosil-ME	222	161	140	115	59



As these results show there is a significant reduction in the concentration of acetaldehyde gas, up to 68% reduction after 6 days, and even a 7% reduction in the dark, when there is no light to activate the reaction.

For further information regarding Keim Ecosil-ME and its features and benefits please contact our sales office sales@keimpaints.co.uk or 01952 231250.