

Statement on Risk Exposure at the Workplace about K-Nanos Compounds

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Kumho Petrochemical produces and supplies Multi-wall Carbon Nanotubes and K-Nanos Compounds for sheet extrusion and thermoforming used as finished product in the packaging of electronic and electrical materials. Typical products include K-Nanos EHI110, K-Nanos EHI210 and K-Nanos EHI120 (HIPS/CNT compounds). Kumho Petrochemical is using own MWCNTs as a raw material for these HIPS/CNT compounds.

There are ongoing studies from institutions in the world with regard to the Human health and the Environment of MWCNTs. Kumho Petrochemical conducted various studies with 3rd party institution. According to Subchronic Inhalation Toxicity study which conformed to OECD Guideline for Testing of Chemicals No. 413 'Subchronic Inhalation Toxicity', NOAEL (No Observed Adverse Effect Level) value for the inhalation toxicity of Kumho's MWCNT was considered to 1.01 mg/m³.

And several studies were conducted about CNT composite area. Many papers showed that it is safe from inhalation issues when MWCNT embedded in a polymeric matrix. Kumho Petrochemical also conducted internal tests whether Free MWCNTs released from K-Nanos compounds or not during the cutting and abrasion of HIPS/CNT compound. The result was that Kumho Petrochemical didn't find Free MWCNTs released from compounds.

Kumho Petrochemical conservatively believe that,

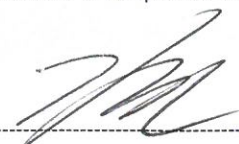
1. There are extremely low possibilities of inhalation MWCNTs when handling with K-Nanos compounds. Because MWCNT was embedded to Resin.

2. Even if there are Free MWCNTs released from K-Nanos compounds during the process of cutting, abrasion and etc..., proposed systemic Derived No Effect Level (DNEL) for worker exposure to MWCNT from REACH legislation for chemicals is 50 $\mu\text{g}/\text{m}^3$ in the air.

3. In Germany case, the acceptable limit of general dust for protection of workers is currently 3mg/m³ (at a density of 2.5g/m³) for the alveolar dust fraction. This will decrease to 1.25 mg/m³ at the end of 2018.

Just extremely assuming that 50% of K-Nanos MWCNT released in free from K-Nanos HIPS compounds (EHI110, EHI120, EHI210) during cutting, abrasion and another external physical attacks. Even in this abnormal case, the concentration of K-Nanos MWCNT in the workplace will be below REACH guideline (50 $\mu\text{g}/\text{m}^3$) of MWCNT when customers manage general dust of workplace under 3 mg/m³. And we actually expect that there will be almost no release of Free K-Nanos MWCNT during external physical attacks. Almost all form of particles will be MWCNT embedded in a polymeric matrix.

As a conclusion, When customers manage general dusts below the guideline in Germany, K-Nanos HIPS compounds can be used safely in finished products from workplace of customers.



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