



Philippe Lemaire

Senior Expert,
Environmental Toxicologist.
TOTAL

Recent studies have found the presence of mineral oil in human tissues (Barp et al., 2014) and Barp, L., et al. (2017), authors have described this presence as being bioaccumulation of mineral oil in human body.

However, it is important to understand that bioaccumulation is one of the components of bioconcentration (accumulation from environment: air, water, soil,...) which is the sum of biomagnification (accumulation from the trophic levels) and bioconcentration. Indeed, it is true that often the term bioaccumulation is used instead of bioconcentration.

Bioconcentration of any substance is the net result of the input (from environment and from food) going into the body minus the output (excretion from the body) and what has been used for metabolism, energy, breeding, and so on. Usually three phases are recognised; the first one is the intake where the input is higher than metabolism, the second one is the steady state where the input is equal to metabolism and the third one is the output where the elimination is higher than intake.

So when should we start talking about bioaccumulation? Unfortunately, there is no clear definition. Indeed, for human toxicology having a BioConcentration Factor (BCF) superior to 1 leads to think the substance could be bio accumulative. For instance, the level from which bioaccumulation is

recognised is not the same according to the different existing regulations in different countries. Indeed, in the past (67/547/ CEE regulation) but also and still now OSPAR (Oslo Paris Convention) a substance is considered as possibly being bioaccumulative if the octanol/water coefficient (the so called Kow showing the lipophilicity of the substance in link with the carbon range, expressed as a logarithmic scale) is above 3 or if BCF ratio is more than 100. From now on with worldwide Global Harmonised System (GHS) a substance would be considered as bioaccumulative if Kow superior to 4 and/or BCF ratio is more than 500. For Persistent and Bioaccumulative and Toxic (PBT) substances, they are considered "bioaccumulative" if KoW is more than 5 and BCF ratio more than 2000.

Usually Kow is the first screening criterion taken into account for a substance to be recognised as being potentially bioaccumulative (Kow superior to 3, 4 or 5). However, molecular length or molecular diameter of a substance should be deeply taken into consideration in order to understand if a substance can bioaccumulate or not. Substances with a high Kow that have reached a certain size will not be able to go through the cellular membrane and de facto will not bioaccumulate. However, for too large substances another phenomena called phagocytosis or pinocytosis by cell membranes can take place. Encapsulation and retention of these large substances does not necessarily mean bioaccumulation.

Bioaccumulation, what is it all about?

According to their carbon range and molecular size, mineral oils have a Kow of more than 11 and are too large substances to cross the cell membrane and be bioaccumulative. Indeed, they can be found in tissues as observed in publications of Barp et al. (2014) Barp, L., et al. (2017) possibly as a result of phagocytosis. Moreover, if mineral oils would be bioaccumulative, increased concentration with age should have been found in human body and that was not the case.

In order to become toxic a bioaccumulative substance must reach what is called the Critical Body Burden (CBB) which means a concentration high enough to have an adverse effect on any endpoint. CBB is the multiplication of the No Observed Adverse Effect Level (NOAEL) by the BCF. However, neither BCF has been determined for mineral oil nor NOAEL based on toxicity.

In conclusion, mineral oils do not fulfil any criteria for bioaccumulation. Their carbon range and molecular size are too big to be bioaccumulative. No BCF has ever been measured in any organism and the CBB has never been reached and cannot be calculated (or shown) as BCF and NOAEL does not exist. Only the presence of mineral oil (not toxicity) has been observed which is emphasized by the fact there is no increment of concentration measured with age.