CO2 capture: Health effects of amines and their derivatives

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CO_2 capture by means of amines is considered to be the most appropriate method to quickly begin with CO_2 removal. During this capture process, some of the amines escaping the recycling process will be emitted into the air and will also form other compounds such as nitrosamines and nitramines. The Norwegian Institute of Public Health (NIPH) was commissioned by the Climate and Pollution Agency (Klif) to assess whether these new emissions are harmful to health - particularly in terms of the cancer risk to the general population. The results of the risk assessments were submitted recently.

These amines by themselves are not very harmful at typical concentrations that might occur, for example, near power plants. However, the amines could take part in complex chemical reactions and form new compounds such as nitrosamines and nitramines, which can affect health and the environment.

There is relatively little knowledge about the various health effects for many of these compounds, but it is known that several of them can be highly carcinogenic. The cancer risk ultimately depends on how much is formed, how much is released, how much is decomposed in the atmosphere by light and how strong the cancer-causing substances are.

The NIPH has assessed the cancer-causing ability of compounds that can be formed in connection with CO_2 capture. Nitrosodimethylamine (NDMA) was found to be one of those that may be the most carcinogenic. Therefore, this compound is used to calculate the risk

from the total amount of various nitrosamines in the air.

Uncertainty about nitramines

There is a lack of knowledge about nitramines but the compounds in this group are generally believed to be less carcinogenic than nitrosamines. However, studies show that the nitramine we know most about, (N-nitrodimethylamine) is a highly carcinogenic substance, although it is not as potent as NDMA.

The NIPH recommends that the risk estimate for NDMA is also used for nitramines. This must be regarded as a risk estimate that will provide good protection of the population. If nitramines are detected in significant quantities in emissions, there will be a need for more knowledge for the NIPH to be able to perform a full risk evaluation.

Recommendation

When released from the CO_2 capture plant, the NIPH recommends that the risk estimate for NDMA should be used for the total concentration of both nitrosamines and nitramines in air and water. We recommend maximum levels that provide minimal or negligible risk of cancer from exposure to these substances. The NIPH therefore concludes that the total amount of nitrosamines and nitramines should not exceed 0.3 ng/m3 (nanogram/m3) air.

Provided by Norwegian Institute of Public Health