Do electromagnetic fields in chlor-alkali production pose a health problem?

Electromagnetic fields (EMFs) are generated by electrical equipment, including those used to make chlorine and caustics. Some people allege health problems to exposure to EMFs, for example from mobile telephone masts and sunbeds. In chlorine plants, workers are exposed to different, i.e. static, extremely low-frequency (ELF) electromagnetic fields of low strength. Based on the currently available science, there is no proof of EMF-related health effect; this is underlined by decades of Euro Chlor experts’ experience with chlorine and caustic industry workers. Despite this, the chlor-alkali industry remains vigilant and the Euro Chlor Health Working Group have written some advice for two specific groups of workers: pregnant women and workers wearing implanted materials and devices.

What are electromagnetic fields?

An electromagnetic field (EMF) is a form of radiation that results from the combination of magnetic and electric fields. In electrolysis units, an electric current runs through a salt solution to transform common (‘kitchen’) salt (NaCl) into chlorine gas (Cl₂), caustic soda or potash (NaOH/KOH) and hydrogen. The flow of electricity through the cells induces a magnetic field and together they generate an electromagnetic field. Many people have heard of EMFs associated with everyday items such as power lines, household appliances, computer screens, communication masts, and mobile telephones. As shown in the figure on pages 2 and 3, those fields generated during chlorine production have extremely low frequencies, which do not interact with the body as much. Not only the frequency, but also the field strength plays a role. A higher field strength may be encountered around some electrical equipment, but overall it remains weak in the major areas of the plant.

Why are people worried about EMFs?

For several years now, there has been rising concern about health effects associated with electromagnetic fields (e.g. from mobile phones and power cables). Living close to power lines has been linked to the development of specific types of cancer and to other health effects. Even though completely different frequencies and field strengths are encountered in chlor-alkali plants, questions are raised by chlorine and caustic soda industry workers.

As a general rule, it must be understood that any health effect due to exposure to an EMF depends mostly on the frequency of the field the person is in. This is because different frequencies interact with the body in various ways. Lower frequency fields may cause stimulation of nerves and muscles, whilst higher frequency fields may cause heating and even tissue damage. As said before, next to the frequency, the field strength will also play a role. Therefore, it is important to consider both parameters.

Directive 2013/35/EU aims to introduce measures to protect workers from the risks associated with electromagnetic fields. It covers all industries, including medical applications (such as MRI) where medical staff is typically exposed to high frequency EMFs. The Directive defines so-called ‘Exposure Limit Values (ELVs)’ for different types of health effects. Above these values, people might experience (e.g.) stimulation of nerve and muscle tissue, altered sensory perceptions, minor changes in brain functions without health effects etc.
Indirect effects via conducting objects
Any metallic (conducting) object, such as a vehicle or a fence that is not electrically grounded, can be charged by an electric field. Anyone who then touches these objects may receive a small electric shock. Whilst one shock might be simply surprising, repeatedly receiving shocks can become annoying or worse. In order to provide the necessary protection, specific training is given and grounding of objects and workers is of benefit. Insulating shoes, gloves and protective clothing are useful here too.

Health effects related to extremely low frequency (ELF) electromagnetic fields

Health effects after short-term exposure
Low frequency magnetic fields, such as those found in chlor-alkali plants, have, under laboratory conditions, shown to cause stimulation of sense organs and stimulation of nerves and muscles (particularly in the arms and legs). The eyes appear to be the most sensitive to the effects of magnetic fields. People experienced ‘phosphenes’, which are elusive, flickering, visual sensations at the edge of vision. They are similar to the effect that can be seen upon gently massaging closed eyes. These laboratory conditions effects only occur when the field strength is sufficiently high. In addition, they are not harmful but may be annoying or distracting.

Health effects after long-term exposure
The EU EMF Directive does not address the issue because there is currently no conclusive scientific evidence linking exposure to ELF EMFs to things like Alzheimer’s, stress, suicide or depression. Therefore, the European Commission continues to monitor the science and, should it be appropriate, the necessary means for addressing potential adverse effects will be considered. Regarding the link between ELF fields and cancer, only one type of cancer is still debated, childhood leukaemia. As children do not form part of the workers’ population, this scientific discussion is not of relevance here.

Electromagnetic Fields

Important worker-specific information

Pregnant women
In over 25 years of study, Euro Chlor occupational physicians have found no literature on the effects of EMF on pregnancy. Nevertheless, European Directives require a detailed assessment of the exposure risk to pregnant workers, as well to chemicals and non-ionizing radiation (including electromagnetic fields). As such, as a precautionary measure, pregnant women should not be allowed to go where the limit for the general public may be exceeded.
Implanted metallic materials and active devices

Implanted metallic materials will neither move or warm up due to those EMFs found in chlor-alkali electrolysis units as the field strength is not strong enough.

The functioning of certain devices, such as pacemakers, defibrillators, drug infusions pumps and continual glucose monitors, may be affected in areas where frequency and field strength are highest. The manufacturer of such devices may certify that the device will not be affected by those fields, but especially older models may be more susceptible.
Therefore, before entering the plant, all workers should be informed of the potential risk posed by exposure of medical devices to EMFs and requested to inform and consult their employer and/or medical doctor. Adequate information should be given to visitors too. Both of these scenarios are summarized overleaf.

**References**


**Euro Chlor initiatives**

Euro Chlor document *Health 10: Electromagnetic Fields in the Chlorine Electrolysis Units - What an Occupational physician should know?* provides a concise explanation on this subject for those who deal with potential health effects of electromagnetic fields. This distills nearly 300 pages of EU EMF Guideline and is available on the Euro Chlor website.

**Acronyms**

<table>
<thead>
<tr>
<th>ALs</th>
<th>Action Levels</th>
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<tr>
<td>ELF</td>
<td>Extremely Low-Frequency</td>
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<tr>
<td>ELVs</td>
<td>Exposure Limit Values</td>
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<td>EMF</td>
<td>Electromagnetic Field</td>
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<td>MRI</td>
<td>Magnetic Resonance Imaging</td>
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This Focus on Chlorine Science (FOCS) is part of a series of leaflets aiming to clarify and consolidate scientific research in the field of chlorine industry. With the FOCS series, we want to facilitate the knowledge gathering of scientists, regulators and key decision makers. For further Euro Chlor science publications, please consult [http://www.eurochlor.org/communications-corner/science-publications.aspx](http://www.eurochlor.org/communications-corner/science-publications.aspx).

**Euro Chlor**

Euro Chlor provides a focal point for the chlor-alkali industry’s drive to achieve a sustainable future through economically and environmentally-sound manufacture and use of its products. Based in Brussels, at the heart of the European Union, this business association works with national, European and international authorities to ensure that legislation affecting the industry is workable, efficient and effective. Chlorine and its co-product caustic soda (sodium hydroxide) are two key chemical building blocks that underpin 55% of European chemical industry turnover.

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