

The importance of precision

Franck Flecheux, director at LEREM, explains innovations in its technological capabilities, as it problem-solves issues facing its members and the wider metal packaging industry

Since 1987, LEREM (Laboratoire d'Etudes et de Recherches des Emballages Métalliques - Metal Packaging Research Laboratory), founded in 1961 on the initiative of the French National Association of Metal Can Manufacturers (SNFBM), has been a non-profit association. LEREM is a member of various French technical and regulatory committees through AFNOR HO8F Committee Group, which designs and deploys solutions based on voluntary standards around the world. The French Committee of Aerosols (CFA), and at the European level, through Metal Packaging Europe (MPE), the European Industrial Packaging Association (EIPA) and the European Aerosol Federation (FEA).

Based in Montataire, the organisation offers its services to its members as well as to all companies working in the metal packaging industry (mainly steel and aluminium manufacturers, food, cosmetics, industrial products and retailers) to solve the problems they may encounter in the vast field of metal packaging and its many applications.

LEREM's routine activities

The market for metal cans is growing steadily mainly due to their durability, stability and safety. Annual European production is about 98 billion units for

various applications (beverages, food, health and beauty, domestic and industrial markets), according to Metal Packaging Europe. The global market for metal packaging is steadily growing and is projected to grow 3.1% from 2020 to 2030.

Metal packaging compares favourably to other types of packaging because of its physical resistance, which provides the possibility of sterilisation or stability when transporting hazardous materials. Metal packaging provides a good physical barrier that limits any contamination or "interaction" between the outer and inner sides of the container. Finally, it is a practical and environmentally friendly solution compared to other types of packaging materials, which, importantly, can be recycled over and over again without losing their inherent properties. However, in order to guarantee these useful properties, it is necessary to strictly control the manufacturing process of the metal packaging and the quality of the final product. The most important requirements for metal packaging are physico-chemical resistance and airtightness.

LEREM is at the disposal of the metal packaging industry, which it supports in:

- 1) Obtaining permits for the transportation of dangerous goods
- 2) Marketing safe aerosols that meet regulatory labelling (flammability and pressure resistance)

- 3) Advising all members of the metal packaging industry (manufacturers, users, relevant bodies).

With the ISO 9001:2015 standard, the organisation has the capability and competence to perform the following tests:

- Approval tests on packages intended for the transport of dangerous goods;
- Mechanical and flammability tests on aerosol dispensers and pumps;
- Laser diffraction particle size analysis;
- Electrochemical and storage tests (at different temperatures) on container-contents compatibility.

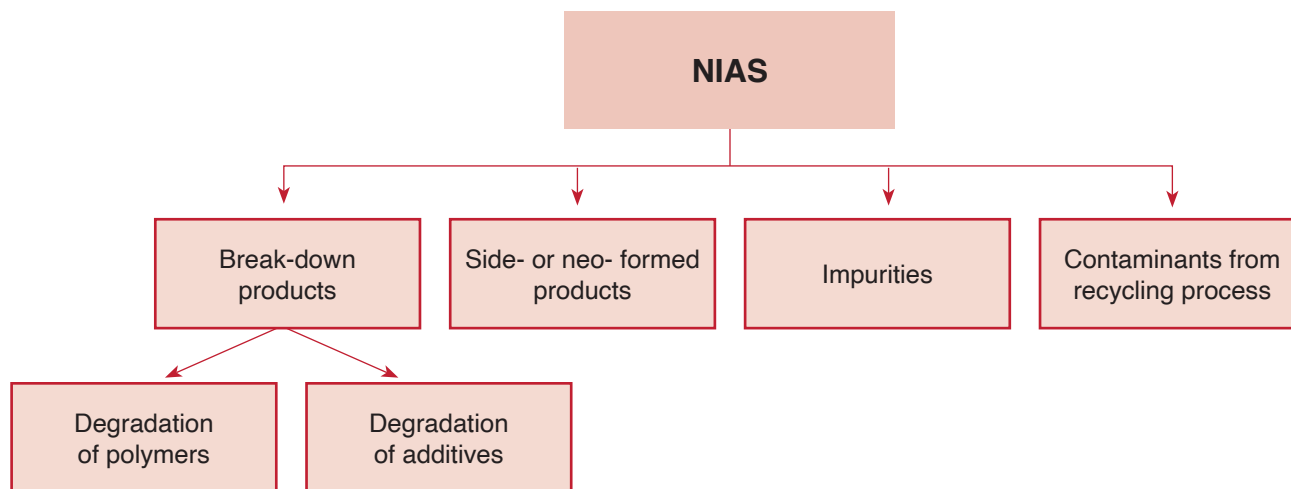
LEREM has extensive experience in tests related to packaging (up to 400 litres) for the transport of dangerous goods. Back in 1997, the association obtained its first approval from the French Ministry of Transport, which is constantly updated for testing, approval of design types and production control.

This expertise is based on regulatory tests such as drop tests, hydraulic pressure tests, leak tests, stacking tests, corrosion tests in accordance with RID, ADR and CLP regulations. Regarding production control, the organisation is responsible for the on-site control of the production of approved packaging, which is repeated every three years as part of the certificate renewal process (ISO 9001).

The firm performs flammability tests, which were regulated in 2007 in the



LEREM has been equipped with brand new equipment



Non-intentionally added substances (NIAS)

European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) and since April 8, 2008, in Directive 2008/47/EC. In France, these tests were included in the decree 2010-323 of March 23, 2010. The test method consists of: a) measurement of the ignition distance for dispersed aerosols; b) flammability of aerosols dispersed in an enclosed space; c) the flammability of aerosol foams. This method allows, depending on the values obtained and the criteria established, to classify aerosols as “non-flammable”, “flammable” or “extremely flammable”. The study on dispersed aerosols can be supplemented with particle size analysis by laser granulometry. This analysis is an important quality control method in various industries such as paints, food and beverages, aerosols, building materials, biocide products as well as in the pharmaceutical industry. Granulometric analysis is mainly used to make sure that the final product meets consumer expectations and, most importantly, is safe for use.

Mechanical tests are performed in accordance with NF H44-023 and FEA 621 standards on empty cans without valves to determine the bursting pressure. Additionally, the mechanical strength of metal aerosol containers as well as glass or plastic containers (aerosol or not) can be determined in accordance with the FEA 623 standard and the Directive 75/324/EEC. In accordance with the draft standard FEA 647, LEREM also tests plastic aerosol cans (cold drop test, hot drop test, product test, water test, water and antifreeze test and hot air test).

LEREM has the equipment and technical skills to carry out on container-contents compatibility using electrochemistry, which can be very effective in determining the suitability of steel containers or selecting appropriate corrosion inhibitors to

limit the corrosion risks of certain container-content pairs.

New tool for electrochemical testing

Impedance spectroscopy is an electrochemical method of measuring the electrical resistance (impedance) of the metal/coating interface when an alternating voltage is applied to a sample at different frequencies. This method has been used in packaging research since the 1980s, and LEREM, for its part, has been practicing this method since the early 1990s, mainly on aerosol cans. The practicality of this method for the metal packaging industry is great because it allows the detection of very small defects (sometimes even smaller than those visible with a microscope), and since this method has no destructive effect, it is possible to measure the same samples repeatedly, ie to follow their evolution over time.

Thus, mathematical models can be calibrated based on repeated measurements from very weak and very accurate electrical signals at different frequencies. Using this data, an equivalent electrical model of the RLC circuit (resistive, inductive, capacitive) can be created. Then an equivalent RLC model can be applied repeatedly at regular intervals to screen the interaction between the inner coating, the substrate, and the filled formulation of coated metal packaging cans.

This test procedure compares favourably with others (ie, storage test, pack test, etc.) as it reduces testing time, thereby speeding up time to market, and decreases the number of samples to be tested (de Vooy et al., 2012; Soares et al., 2020)¹. Equipment and measurement processing systems are constantly evolving, and as LEREM strives to keep up with the latest innovations, from December 2021 the association has been equipped with brand new, state-of-the-art

and more accurate (10 times more sensitive) equipment.

A new direction – analytical studies

Recently, special attention has been paid to the materials and chemicals used to produce food contact materials (FCM). At the European Union (EU) level, FCMs are subject to the framework regulation EC 1935/2004. This regulation stipulates that FCMs must not alter the organoleptic and nutritional properties of food and must not transfer their components into food in quantities that could endanger human health. This Regulation applies to all substances that can migrate from FCMs, including so-called non-intentionally added substances (NIAS). Although EU legislation permits the presence of NIAS in FCMs, a risk assessment involving the identification and characterization of molecules migrating, as well as an assessment of exposure levels, is required. LEREM assists metal packaging manufacturers who want to ensure the safety of their materials, and carries out NIAS studies (identification, semi/quantification) using high resolution mass spectrometry techniques. The study of NIAS in FCMs will allow packaging manufacturers to confirm that their products are in accordance with current regulations and will help them comply with any regulatory changes.

References

1. de Vooy, A. C. A., Boelen, B., & van der Weijde, D. H. (2012). Screening of coated metal packaging cans using EIS. *Progress in Organic Coatings*, 73(2-3), 202-210. <https://doi.org/10.1016/j.porgcoat.2011.10.019>;
- Soares, C., Tenreiro Machado, J. A., Lopes, A. M., Vieira, E., & Delerue-Matos, C. (2020). Electrochemical impedance spectroscopy characterization of beverages. *Food Chemistry*, 302. <https://doi.org/10.1016/j.foodchem.2019.125345>

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