ICL Industrial Products

Where needs take us

Flame Retardants Additives: an innovative fitness for use approach

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Agenda

- Introduction –ICL-IP
- Flame Retardants Market, Safety trends
- Fitness for Use: SAFR® methodology

ICL –Industrial Products (ICL-IP)

$5.2bn sales in 2017

Manufacturing sites spread around the world

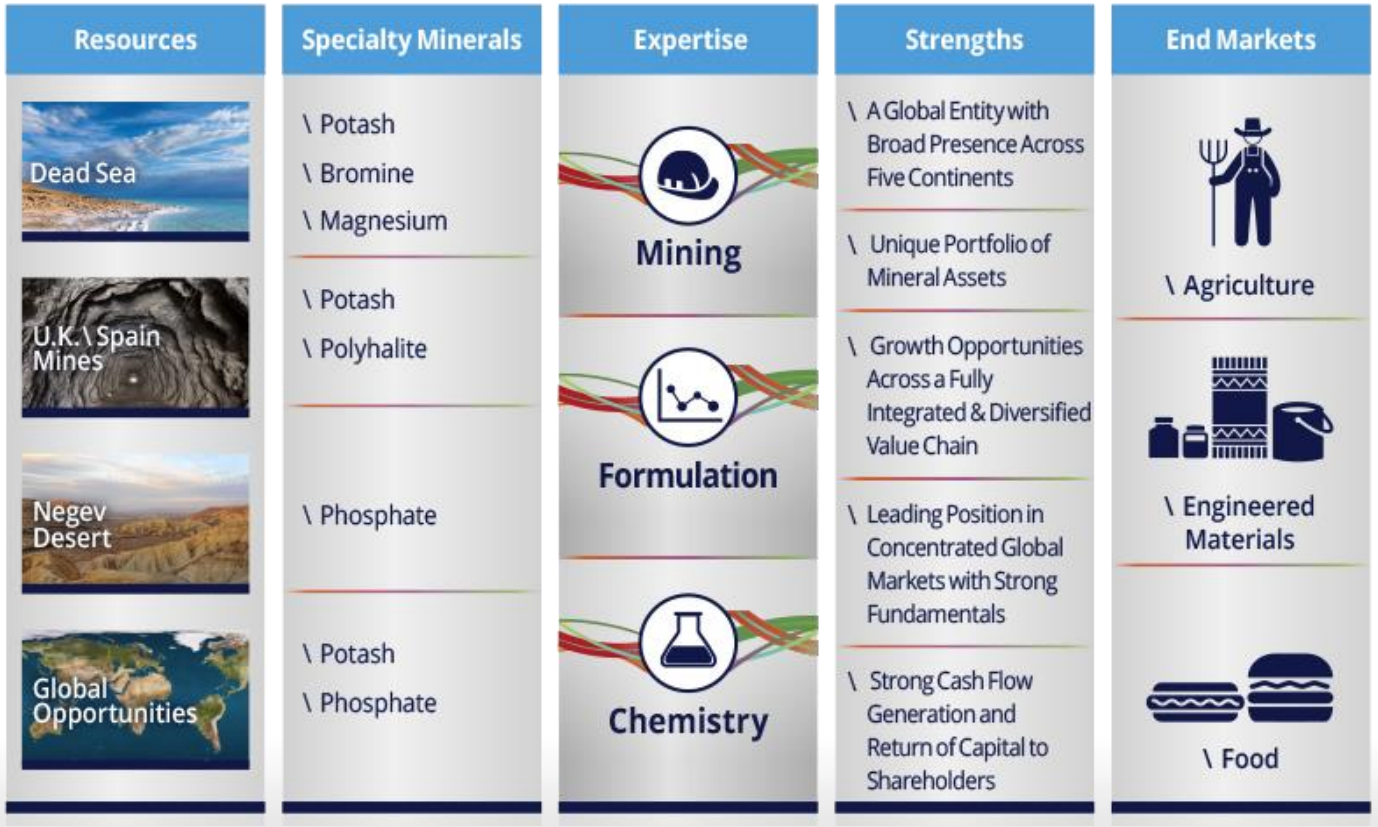
~13,000 Employees

5 R&D centers with 500 researchers

- 772 granted patents and 316 pending patent applications

Defining ICL's Identity: "Where Needs Take Us"

- Leading Specialty minerals company fulfilling essential needs in Agriculture, Food and Engineered Materials.
- Engineered Materials →Specialty Solutions
  - Innovating to create sustainable fire safety and promoting public safety



Main Market Trends

Market (R)evolutions

- **Energy saving (transportation, electricity)**
- **Communications and interconnection (automotive, appliances, smart homes)**
- **Miniaturization (E&E components)**
- **Display devices**

Main Market Trends – Requirements for Flame Retardants

- ***Chemistry shifts driven by regulation (DBDPO, HBCD)***
- ***Environmental concerns and Sustainability***
- Cost / efficiency performances
- Low or no impact on overall, non–FR properties
- Energy efficiency: low weight
- Thermal stability: process
- Thermal resistance: useful service life
- Moldability, flowability
- Fitness for use in the final application

Main Market Trends: Standards & Regulations

- EU: Standards' Harmonization, CPR, EN-45545
- US: Upholstery, furniture compliance suppression
- Fire Safety criteria evolution:
  - Smoke opacity (time to escape)
  - Smoke toxicity (less casualties)
  - Focus on external ignition (candle) shifted to internal (internal space decrease)
  - Bigger plastic articles & parts, higher contribution to flashover

ICL-IP approach for addressing market's needs

- ***Need**: Address chemistry shifts driven by regulation*
  - ***ICL-IP action** : Phasing out hazardous substances*

- ***Need**: Address environmental concerns and sustainability issues*

  - ***ICL-IP action** : Launching* **SAFR®**, *enabling users to choose the most sustainable product for the intended use*

SAFR®

A SYSTEMATIC ASSESSMENT FOR FLAME RETARDANTS

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CONTENT

1

WHY

an assessment framework for flame retardants (FRs)?

2

WHAT

is SAFR?

3

HOW

does SAFR work?

4

WHY SAFR

stands out?

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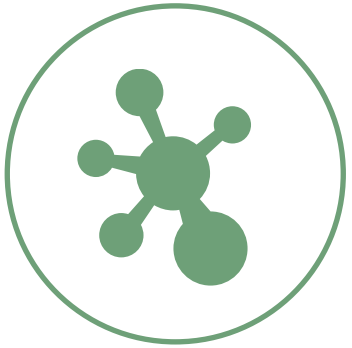
Flame Retardants

Providing safety to modern comfort



What are they?

Responsible choices start with product design

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SYSTEMATIC ASSESSMENT FOR FLAME RETARDANTS

WHAT IS SAFR?

- An easy-to-follow **systematic assessment framework for flame retardants (FRs)**
- Evaluation of specific FRs in their applications
- Enables users to choose the **most sustainable product for the intended use**
- **Science-based methodology**
- **Based on both the hazard and the potential exposure** during the intended use

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HOW DOES SAFR WORK?

Building on accepted hazard criteria, SAFR assesses the extent to which hazards translate into potential risks due to possible exposure to humans and/or the environment during a product's service life.

HAZARD + EXPOSURE ⇒ RECOMMENDATION

HAZARD / EXPOSURE	LOW	MEDIUM	HIGH	UNACCEPTABLE
LOW POTENTIAL	RECOMMENDED	RECOMMENDED	ACCEPTABLE	TO BE PHASED OUT
MEDIUM POTENTIAL	RECOMMENDED	ACCEPTABLE	NOT RECOMMENDED	
HIGH POTENTIAL	ACCEPTABLE	NOT RECOMMENDED	NOT RECOMMENDED	

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ASSESSING HAZARD

OUR STARTING POINT

Defined 13 endpoints which include human health and environment

CRITERIA

Based mainly on the Global Harmonized System (GHS) for classification and labelling

ASSESSMENT

Asses the hazard for the FR and its relevant degradation products

FINAL HAZARD SCORE

Given according to SAFR® hazard categories

THE ENDPOINTS

Environment

- Acute ecotoxicity
- Chronic ecotoxicity
- Persistency
- Bioaccumulation

Human Health

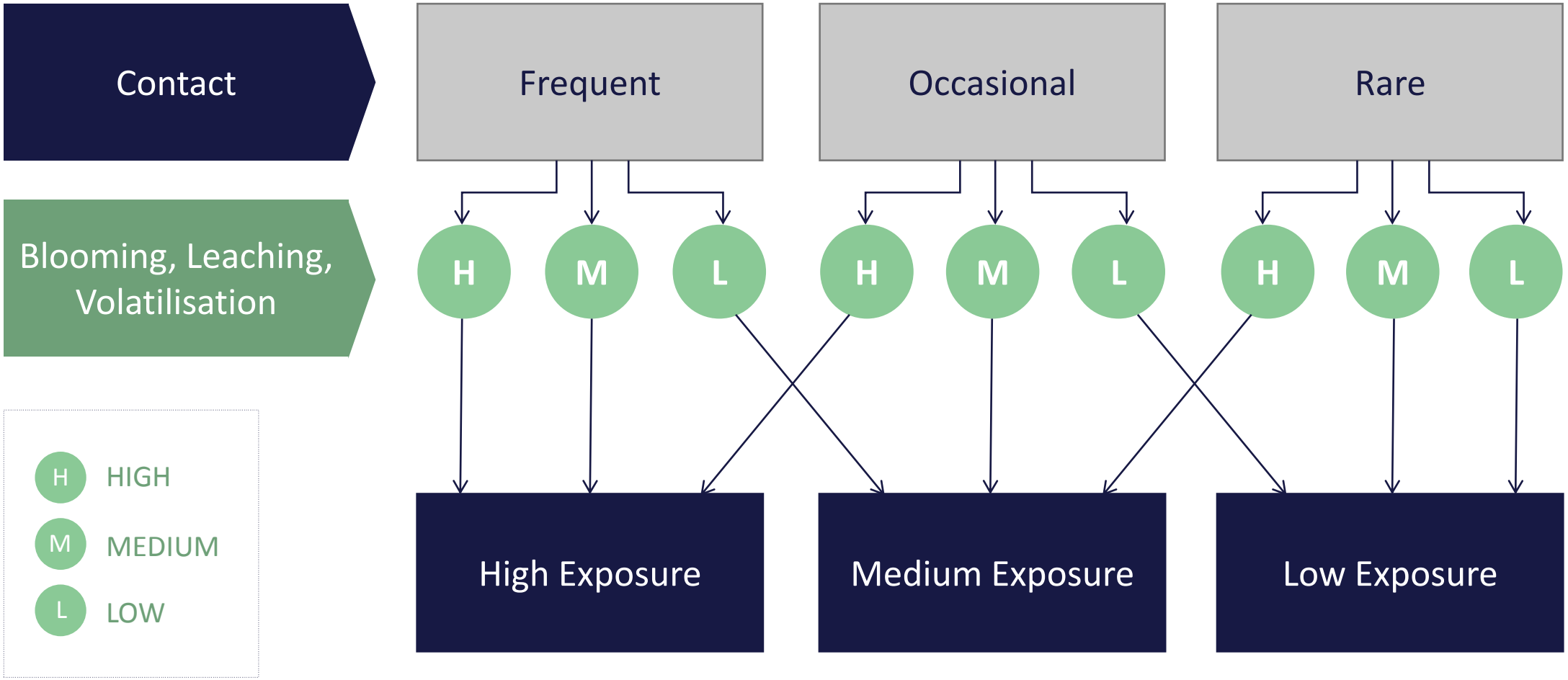
- Acute mammalian toxicity
- Systemic toxicity/organ effects
- Respiratory or skin sensitization
- Skin corrosion/irritation
- Serious eye damage/eye irritation
- CMR
- ED

HAZARD SCORING

Hazard Category	Hazard Criteria
Unacceptable Hazard	Very High Human Toxicity **OR** Very High P* + Very High B**
High Hazard	High P + High B **OR** Very High P + High Ecotoxicity **OR** Very High B + High Ecotoxicity **OR** High Human Toxicity
Medium Hazard	Moderate P + Moderate B **OR** High P + Moderate Ecotoxicity **OR** High B + Moderate Ecotoxicity **OR** High Ecotoxicity **OR** Moderate Human Toxicity
Low Hazard	When none of the above apply

P : Persistency*
*B **: Bioaccumulation*

ASSESSING EXPOSURE



1

Frequency of contact

OCCASIONAL

Less than daily contact during the intended or primary use of the product (e.g. automotive under the hood equipment, printers' cartridges)

FREQUENT

Daily contact during the intended or primary use of the product (e.g., car seats, external casing of TVs and computers, carpet underlay, upholstery furniture, electrical socket)

RARE

e.g. connectors in electronic/electric equipment, insulation boards, printed wiring boards

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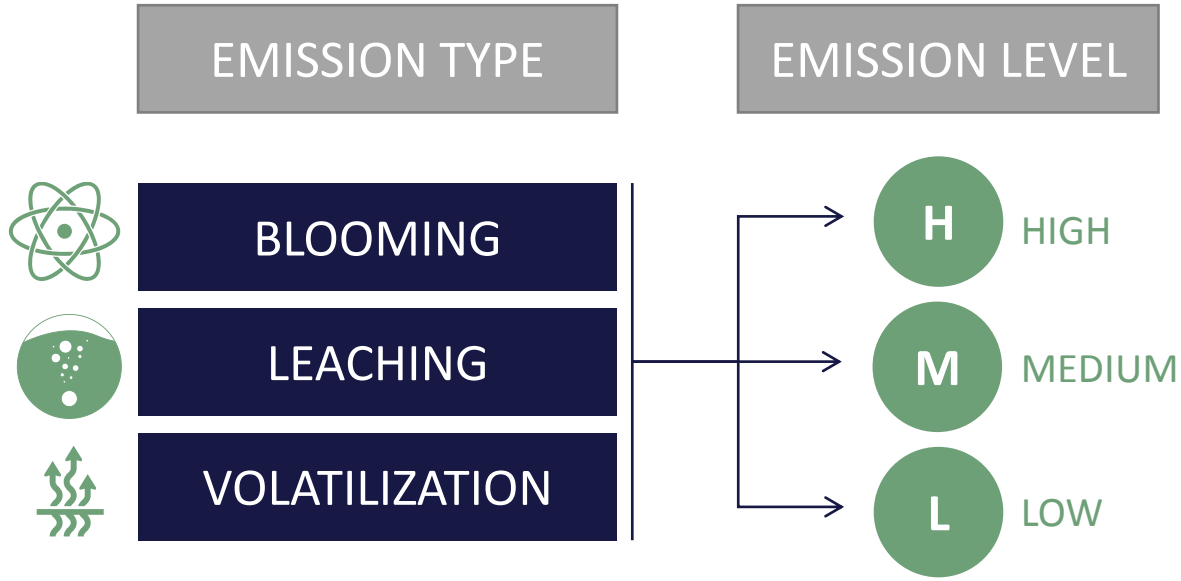
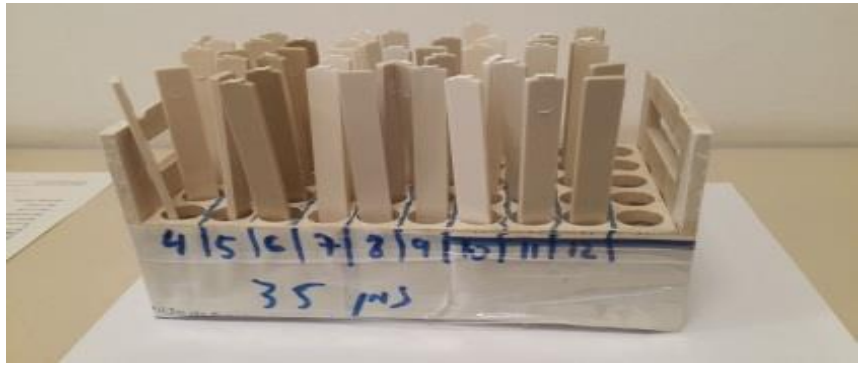
2

Potential emissions



BLOOMING

- Preparation of **plastic samples** according to known formulation
- **Ageing** of samples at 70°C for 35 days
- **Sweeping** of samples
- **Analysis** of filters for bromine



Blooming levels µgBr⁻/cm² : Low/No: Br⁻ ≤ 1 , Medium: 1< Br⁻ ≤10 , High: Br⁻ > 10

LEACHING

- Preparation of **fabric samples**
- **Soxhlet** extraction of the fabric (8 hours)
- Water **evaporation**
- **Analysis** of solid extracts for bromine

Leaching levels mgBr^-/m^2 : Low/No: $Br^- < 5$, High: ≥ 5

VOLATILIZATION

- **Preparation of PU foam samples** according to a generic formulation (e.g automotive)
- **VOC** and **FOG** analyses based on **VDA 278**
- Current of inert gas
  - **VOC:** 30 minutes at 90 °C
  - **FOG:** 60 minutes at 120
- Analysis using GC-MS

Volatilization level mg/Kg: **Low: VOC < 50 OR FOG <125**
High: VOC ≥ 50 OR FOG ≥ 125

RESULTS – TEXTILES CASE

Flame Retardant	Hazard	Exposure	Uses		
			RECOMMENDED	ACCEPTABLE	NOT RECOMMENDED
TexFRon® 9001	**L**	**M**	**Textile:** Upholstery, drapes, carpets, tents		
TexFRon® P, P+ PL	**L**	**M**	**Textile:** Professional protective clothing		
TexFRon® 4002 PL	**L**	**L/M**	**Textile:** Upholstery, drapes, carpets, tents **Transportation:** Seats' covers, carpets, covered parts (filters)		
FR-1410	**L**	**H**		**Textile:** Upholstery, drapes, tents **Transportation:** seats' covers and carpets	
Fyrol® FR-2 (TDCP)	**H**	**H+**			**Textile:** Tents
FR-1210 (Deca)	**UNACCEPTABLE**	**NR**	**BEING PHASED OUT**		

OUR APPROACH TO POLYMERICS & REACTIVE FRs

SAFR ASSESSMENT		SAFR RESULT	
	BIOAVAILABILITY	HAZARD →	LOW
	LEACHING		
	BLOOMING	EXPOSURE →	LOW

Recommended

We are developing FRs which are either large polymers or reactive FRs that are chemically integrated into polymer backbones forming flame retarded polymers.

The reactive FRs will behave like polymeric FRs once fully reacted.

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100% of ICL products have undergone a SAFR assessment

45 FRs assessed

All new products in assessment pipeline

In 30 applications

In 20 kinds of polymer matrices

RESULTS OF OUR PORTFOLIO ANALYSIS

65 % SAFR®
Recommended for specific applications

ICL encourages a more sustainable flame retardant

10 % SAFR®
Non-Recommended for specific applications

25 % SAFR®
Acceptable for specific applications

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WHY SAFR? WHAT MAKES US DIFFERENT?

RISK-BASED

- Transparent methodology
- Can be applied to other plastics additives

CHOICES

- Design phase
- Alternative assessment

SCIENCE

Grounded in scientific facts

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The team

The core team: Ilan Elkan, Anantha Desikan, Marc Leifer, Smadar Admon

Tami Weiss-Cohen and the HERA team

Mazal Wegner and the Analytical lab

Eyal Eden and the Plastics Application lab

Ella Rapoport and the Textile lab

Jeff Stowell and the R&D team

Joel Tenney and the advocacy team

Thank You!

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