

FIRE AND EXPLOSION RISK ASSESSMENT RELATED TO THE DISPOSAL OF UNDER PRESSURE CONTAINERS (AEROSOLS) AND PROCEDURES FOR RISK MITIGATION

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PROPELLANTS

- ✓ rare gases;
- ✓ nitrogen;
- ✓ carbon dioxide;
- ✓ nitrous oxide (laughing gas);
- ✓ air;
- ✓ butane;
- ✓ isobutane;
- ✓ propane;
- ✓ dimethyl ether;
- ✓ Difluoroethane.



SIMULATION BREAK FOR TEARING OF THE AEROSOLS CONTAINERS AND THE RISK ASSESSMENT RELATED TO THE RELEASE OF FLAMMABLE ATMOSPHERES.

Continuous measurements multi-gas detectors (model AreaRAE steel, RAE Systems) made on the following parameters:

- Oxygen concentrations (O_2 in volume%);
- Vapors of Volatile Organic Compounds (VOCs as ppm or mg / m^3);
- Lower Explosion Limit “LEL” of the mixture.

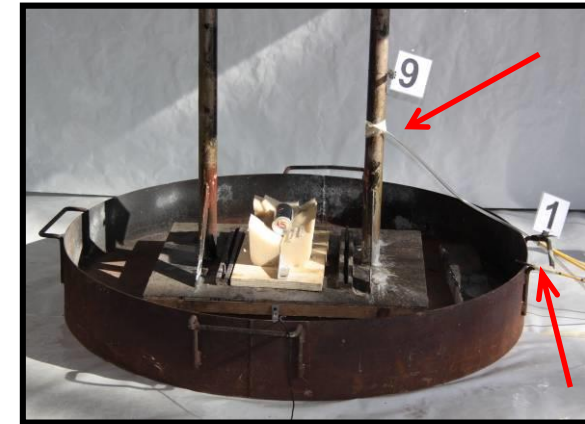


Sensors positioning



NB:

The sensors were placed in order to accurate monitoring volumes where the propellant dispersed stratifies



Position	sensor 9	sensor 11	sensor 12	sensor 10
D (cm)	24	60	110	150
H (cm)	26	20	27	35
R (cm)	35	63	113	153

DESCRIPTION OF THE BREAKING TESTS AND ANALYSIS OF RESULTS

The evidence suggests:

- A. The oxygen rate never falls below the minimum level necessary for the proper operation of the catalytic sensor (LEL);
- B. reaching the value of LEL alarm, corresponding to the threshold of the LEL methane equivalent, it's equivalent to clearly excess over the LPG LEL, and clearly excess the dimethyl ether LEL (methyl ether);
- C. concentrations of L.E.L. measured by the instrumentations represent a layering effect of the dispersed gas on the bottom;
- D. LEL sensors measurements indicate that at a distance over 100 cm from the breaking point there aren't flammable atmospheres.

samples:

- *n. aerosols*: 17
- *Capacity* : 300/400 ml
- *Propellant* : butane, propane and isobutane or hydrocarbons mixtures.

every single break released a quantity of flammable substance able to generate in few seconds an atmosphere falling within its flammable range, for distances up to 60 cm.

GASES MIXTURE TRIGGER TEST



Has also been verified during the tests the ignition possibility of the dispersed cloud by an electric pulse.

The test revealed that:

- 1) a single canister is able to produce considerable quantity of flames, for a considerable time;
- 2) after the trigger a dart of fire originates in the preferential direction of the dispersion;
- 3) rapid spread of flame to the product dispersed;
- 4) high altitude reach by flames of approximately 1.5 m;
- 5) significant flame volume.



CONCLUSION ON THE TEST RESULTS

1. Each single breakage releases a quantity of extremely flammable propellant gas (in 6 of 17 trials carried out, the escaped gas was within the flammability range).
2. Up to a distance of about 60 cm, in few seconds, the LEL sensors went into alarm in almost all the test performed.
3. The progressive breakage of more spray cans, without the prior removal of the gas contained in them, determines the rapid formation of flammable mixtures, also after a few breakages.
4. Maximum concentrations of flammable gases, were in the lower part, where the heaviest part of the product stratifies.
5. Summary of instrumental experimentation results.

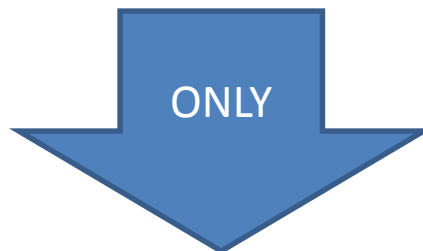
Id. NIA	Peso gr.	Prodotto	LEL% Strum.9	LEL% Strum.10	LEL% Strum.11	LEL% Strum.12
1	204,49	Personal Color	13,14	0,00	100	0,00
2	321,60	Berner Degrippante	0,00	0,00	0,00	0,00
3	372,88	Dupli Color	100	13,14	100	0,00
4	366,08	Personal Color	100	14,04	34,20	0,00
5	256,82	Brico Color	24,48	0,00	86,76	0,00
6	294,64	Colorone 1	21,96	0,00	100	0,00
7	159,66	Acricolor	4,68	0,00	100	0,00
8	287,23	Macota Tubo	0,00	n.d.	42,84	0,00
9	95,66	Intesa Schiuma	0,00	n.d.	20,16	0,00
10	309,68	Quik Smalto	46,08	2,34	42,48	0,00
11	330,39	Macota Base	45,90	0,00	53,04	0,00
12	137,04	Noxzema Schiuma	0,00	0,00	0,00	0,00
13	73,26	Mir Fresh deodorant spray	0,00	0,00	0,00	0,00
14	74,98	Deo Vaniglia	0,00	0,00	0,00	0,00
15	341,51	Saratoga Happy Color	0,00	4,14	0,00	0,00
16	80,55	Puli Svelt	10,26	0,00	12,78	0,00

Summary of the results of instrumental experimentation

STATE OF THE ART ON DISPOSAL OF AEROSOLS



In Italy and in Europe there are no binding regulations on how to dispose of aerosol cans
good practice standards



good practice standards

NB: In Italy the Ministerial Decree 13.10.1994 identifies precautions for bottling, from which can be deduced with appropriate adjustments, the proper procedures for disposal.

STATE OF THE ART ON DISPOSAL OF AEROSOLS

In order to prevent the risk of formation of flammable/explosive mixture, it is advisable to perform the following preliminary operations:

- 1. sorting of spray cans with division of the product in function of the degree of filling;*
- 2. selection of the aerosol according to the degree of danger, (flammable, harmful and toxic);*
- 3. pre-treatment of spray cans for total elimination of gas before shredding.*



STATE OF THE ART ON DISPOSAL OF AEROSOLS



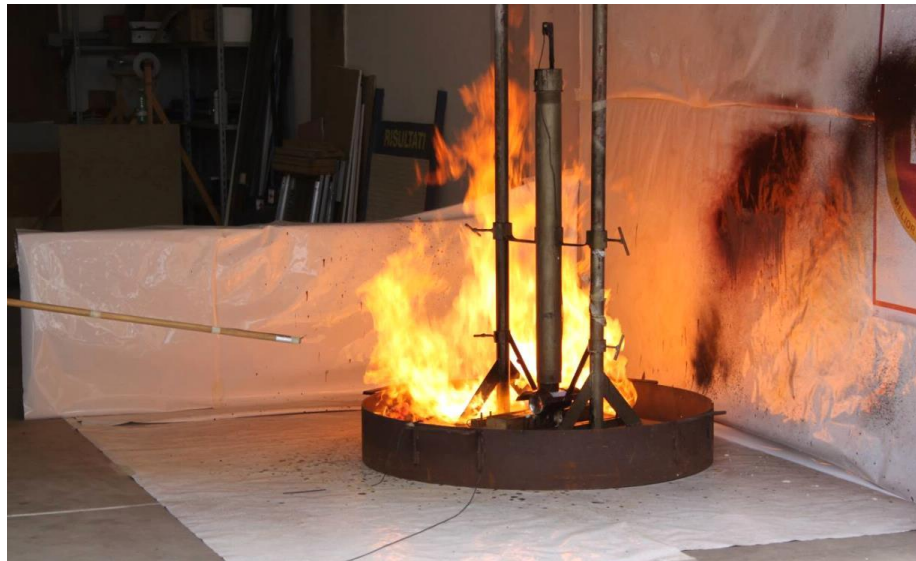
The British Aerosol Manufacturers' Association (BAMA), in the "recycling post-consumer aerosols" study, provides the following information:

- 1. the space within a meter vertically and horizontally from the press must be considered ATEX Zone 2, together with the space occupied by the last compressed cans packs;*
- 2. the compactor (BALER) and any other devices must be suitable for use in zone 2, then up to the series of product standards EN 60079 ATEX;*
- 3. Control of the filling level;*
- 4. perforation of the can;*
- 5. recovery of the material for recycling.*

NB: in case of cans containing highly flammable products, the ATEX zone could even be more severe and therefore, as a precautionary measure, should be considered at least zone 1, or even zone 0.

CONCLUSION

Spray cans treatment as waste, through the breakage of the metal casing not preceded by prior cleaning of the container, certainly gives rise to the possible formation of flammable mixtures not only due to the presence of the propellant but also to the nature of its content.



It is necessary, also in compliance with the provisions of the norms on Health and safety at work (Legislative Decree no. 81/08), to carry out appropriate assessments on fire risk and particularly risk of the explosive atmospheres formation.

Thank you