Food gases from farm to fork

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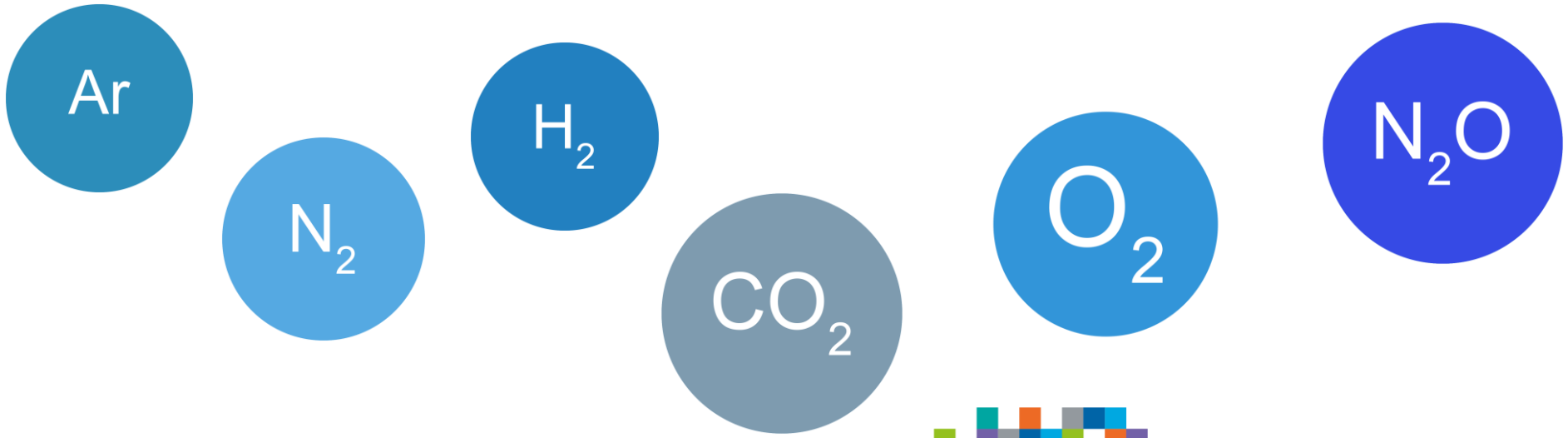
Chair WG8 Food&CO2

Food Gases

- Gases are used in the food industry for various purposes.
- They can be used as additives, ingredients and processing aids when the gases are additive they are considered Food.
- The developments in European legislation mean that the gases supplied to the food industry shall be in compliance with increasingly stringent standards in order to come into contact with food and therefore to be able to guarantee food safety.



Foodstuff

Food companies

Regulation EC 1333/2008

Food Additive-Processing Aid

Regulation EC 1333/2008 defines requirements and the list of food additives

- Carbon dioxide E290
- Argon E938
- Nitrogen E941
- Helium E939
- Hydrogen E949
- Oxygen E948
- Nitrous Oxide E942

ANNEX I

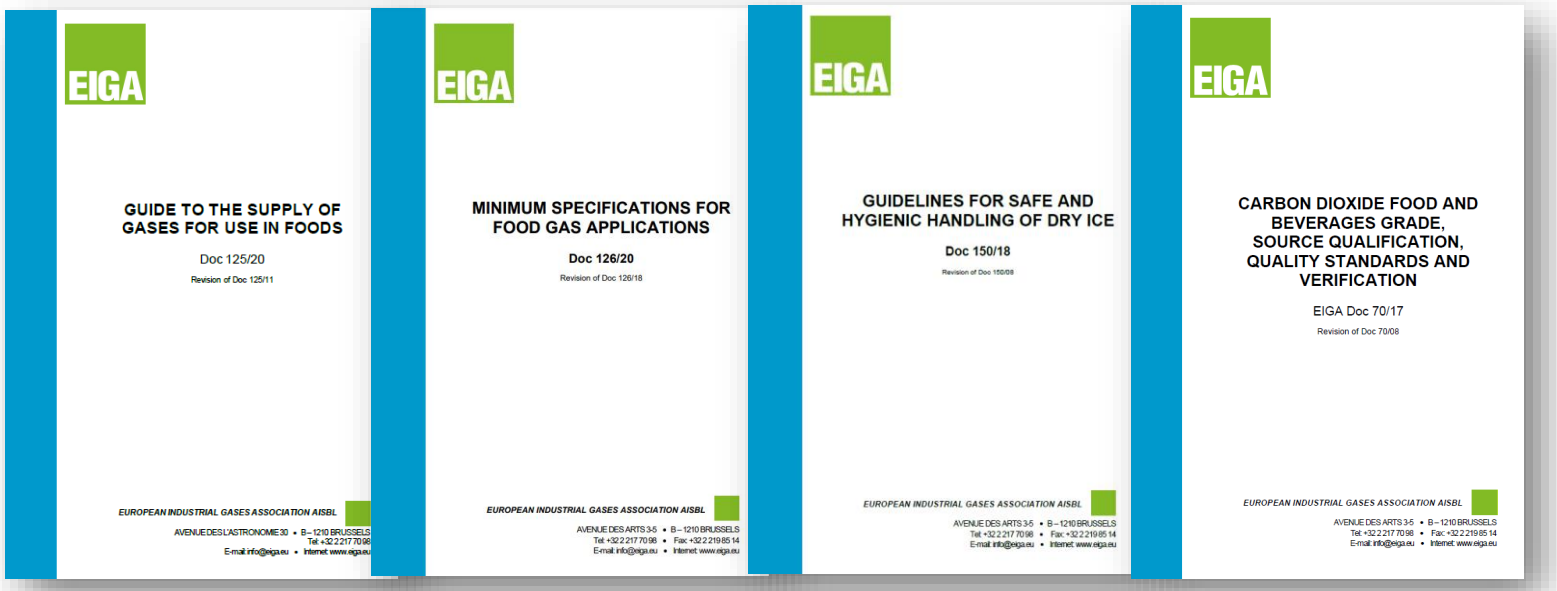
Functional classes of food additives in foods and of food additives in food additives and food enzymes

15. 'foaming agents' are substances which make it possible to form a homogenous dispersion of a gaseous phase in a liquid or solid foodstuff;

20. 'packaging gases' are gases other than air, introduced into a container before, during or after the placing of a foodstuff in that container;

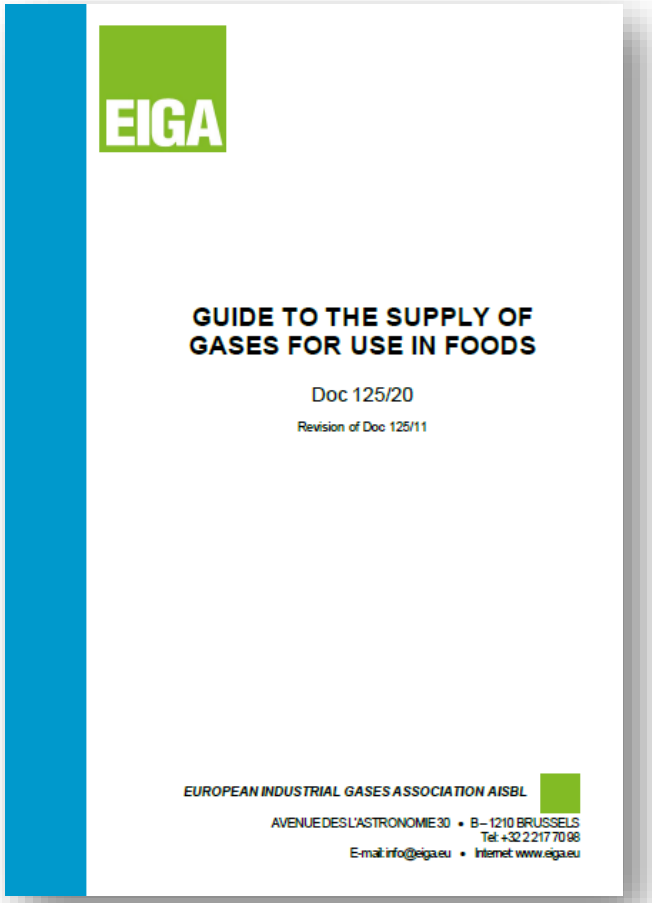
What Does Legislation Mean to Us?

- It means that we have to realise that we are supplying “foods”
- We have to consider the health of the end consumer
- We have to meet many other requirements that apply to foods



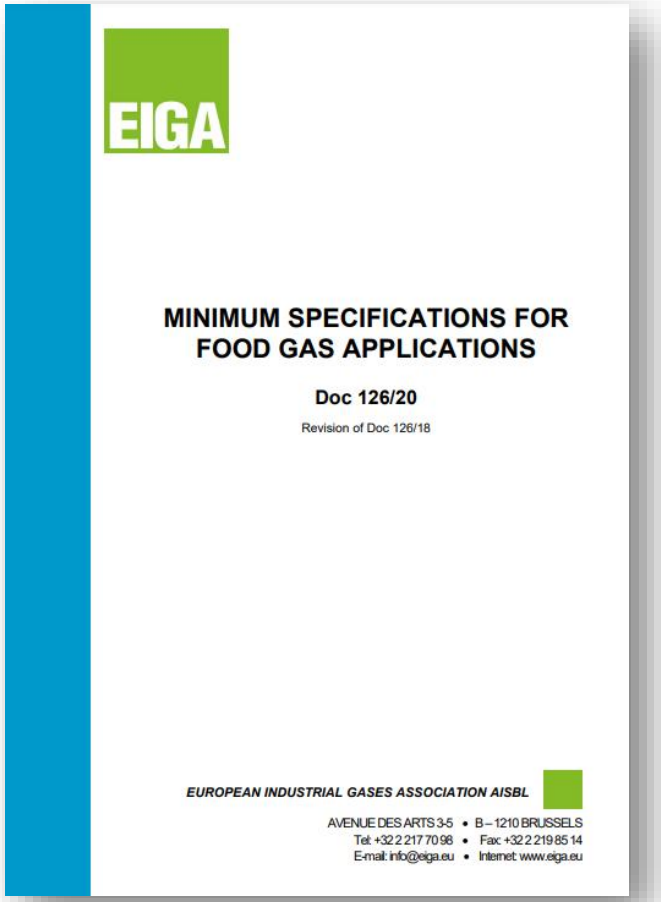
What are these Requirements?

- Labelling E-number
- Traceability
- Purity Criteria
- Registration of Premises
- Hygiene HACCP
- Food Contact materials



Purity Criteria Food Additive E-number

Regulation EU 231/2012 lay down the purity criteria of food additives



	O_2	N_2	Ar	CO_2	N_2O	He	H_2
E number	**E 948**	**E 941**	**E 938**	**E 290**	**E 942**	**E 939**	**E 949**
Minimum purity	> 99%	> 99%	> 99%	> 99%	> 99%	> 99%	≥ 99.9%
Moisture	≤ 0.05%	≤ 0.05%	≤ 0.05%	-	≤ 0.05%	≤ 0.05%	≤ 50 ppm
THC	≤ 100 ppm	≤ 100 ppm	≤ 100 ppm	-	-	≤ 100 ppm	-
O_2	-	≤ 1%	-	-	-	-	≤ 10 ppm
N_2	-	-	-	-	-	-	≤ 750 ppm
CO	-	≤ 10 ppm	-	≤ 10 ppm	≤ 30 ppm	-	-
$NO+NO_2$	-	≤ 10 ppm	-	-	≤ 10 ppm	-	-
NVOC	-	-	-	≤ 0.1mg/l	-	-	-
Reducing agents: H_2S, phosphide, etc	-	-	-	To pass JEFCA test	-	-	-
Acidity	-	-	-	To pass JEFCA test	-	-	-

Carbon Dioxide in Beverage

REGULATION (EU) No 1169/2011

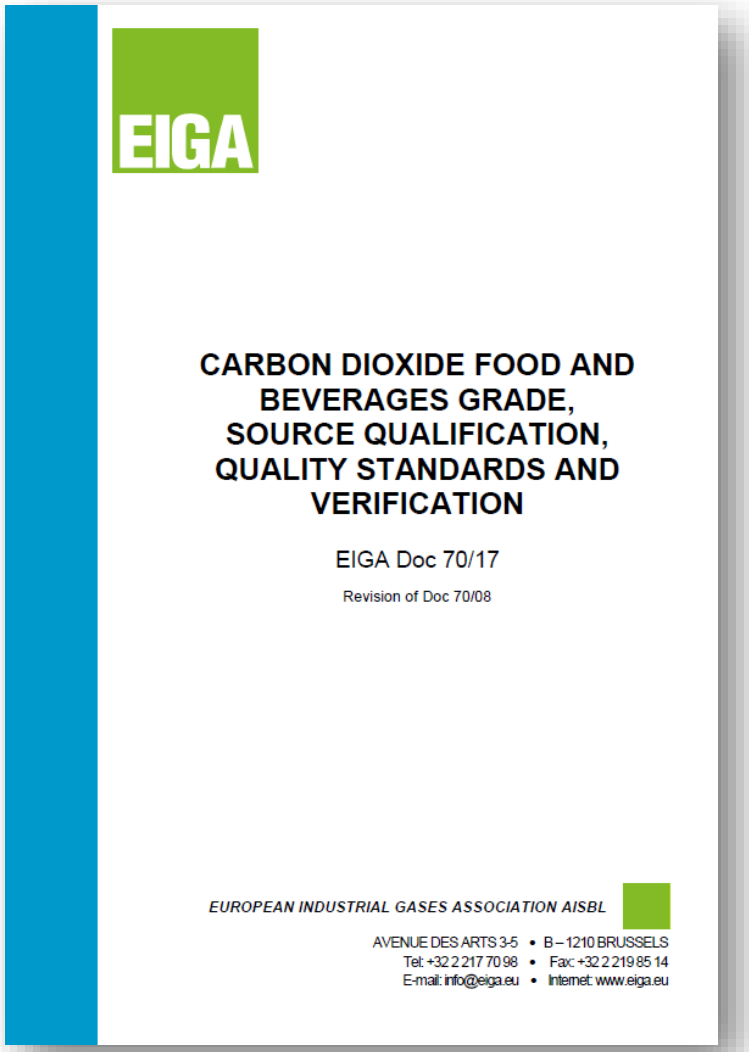
'ingredient' means any substance or product, including flavourings, food additives and food enzymes, and any constituent of a compound ingredient, used in the manufacture or preparation of a food and still present in the finished product, even if in an altered form; residues shall not be considered as 'ingredients';

INGREDIENT

any substance which is used in the preparation of a food and which is still present in the finished product, even if in altered form

Carbon dioxide for soft drinks

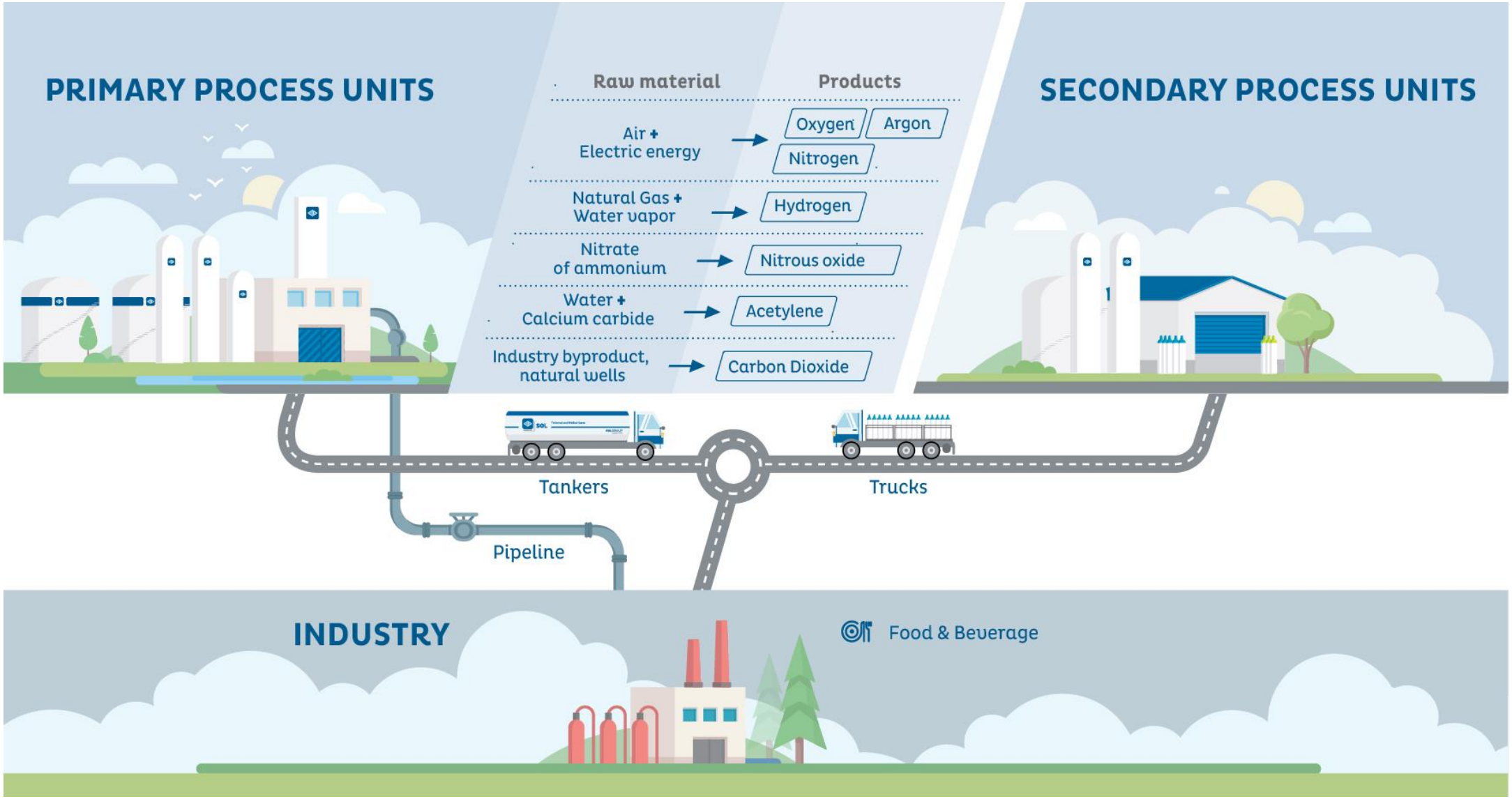
Carbox Dioxide in Beverage



isbt | international society of beverage technologists

Parameter[1]	Guideline Limit
Purity:	99.9 % v/v min.
Moisture (H_2O):	20 ppm v/v max.
Oxygen (O_2):	30 ppm v/v max.
Carbon Monoxide (CO):	10 ppm v/v max.
Ammonia (NH_3):	2.5 ppm v/v max.
Nitrogen Monoxide (NO):	2.5 ppm v/v max.
Nitrogen Dioxide (NO_2):	2.5 ppm v/v max.
Non-volatile Residue (NVR):	10 ppm w/w max.
Non-volatile Organic Residue (NVOR):	5 ppm w/w max.
Methanol (MeOH):	10 ppm v/v max.
Total Volatile Hydrocarbons (THC): (as Methane)	50 ppm v/v max. (including 20 ppm v/v max. as total non-methane hydrocarbons [TNMHC])
Acetaldehyde (AA):	0.2 ppm v/v max.
Aromatic Hydrocarbon (AHC):	20 ppb v/v max.
Total Sulfur Content (TSC as S): (Total sulfur-containing impurities excluding sulfur dioxide)[2]	0.1 ppm v/v max.
Sulfur Dioxide (SO_2):	1 ppm v/v max.
Odor of Solid CO_2 (Snow):	No foreign odor
Appearance of Solid CO_2 (Snow):	No foreign appearance
Odor & Taste in Water:	No foreign odor or taste
Appearance in Water:	No color or turbidity

Food Gases supply chain



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Primary production plants

- Primary plants produce high purity products for a wide range of demanding end uses
  - Generally designed and operated to produce products suitable for all intended applications

- Operate continuously in closed, pressurised systems
  - Risk of environmental contamination are negligible
  - Production for other high purity applications does not automatically qualify plants for food use

Primary Production plants

A number of legal Food Safety requirements apply

- Production sites are “Food Premises”
- Design and construction to ensure effective cleaning and maintenance operations
- Product labelling to clearly identify product suitable for food use
- Effective product batch control and traceability systems
- Food safety awareness training, personnel impacting product integrity-HACCP plan

Bulk Food Gas distribution

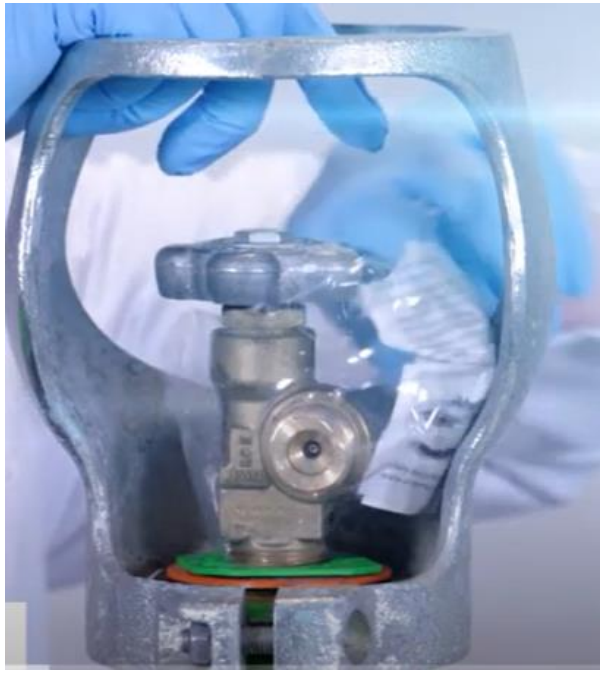
- Traceability has to be established on the entire bulk gas distribution to initiate effective withdrawal procedures
- Risk Assessment Procedure HACCP as a part of the documented overall quality system is to be installed

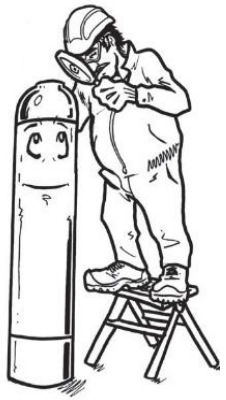
Secondary plants

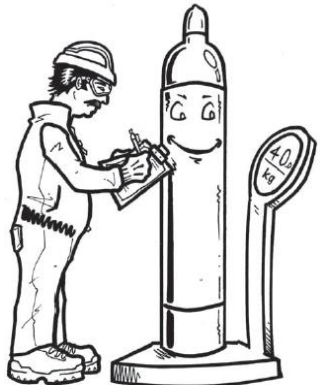
- Filling equipment for food gases don’t need to be exclusively dedicated.
- Only filled from food grade bulk tanks.
- Documented procedure to classify a cylinder as suitable for food service.
- Risk Assessment Procedure HACCP as a part of the documented overall quality system shall be present.

Secondary plants: Filling cylinders

- Inspection for cleanliness prior to fill food gases.
- Only filled from food grade bulk tanks.
- Food gases must be kept separated from non food gases.
- Filling procedure in place.
- Use of residual pressure valve is strongly recommended.







Secondary plants: Dry ice

Dry ice is the solid form of CO2 and due to the low temperature -78°C it can be used for many food application as cooling agent in contact with food

- The carbon dioxide of origin shall be certified for food use E290 in order to guarantee the quality of the dry ice as food
- DryIce is not produce in a close cycle so the production-distribution shall be applying a strong HACCP plan to guarantee the finished product

Food Contact Materials

The Reg EC n° 1935/2004 and Reg EC n°2023/2006 impose controls of possible effects related to migration processes of contaminants from packages, including carbon steel cylinders, to food gases, stating that all materials and products in contact with food should be manufactured in compliance with the general and specific rules on guidelines for developing good manufacturing practices and standard operating procedures.

Food Contact Materials

Packaging Technology and Science
An International Journal

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Migration Processes of Metal Elements from Carbon Steel Cylinders to Food Gases

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This study is aimed to provide a protocol for sampling and analysis of metal elements migrating from carbon steel cylinders, used for gas storage and distribution, to food gases, i.e. those gases, such as CO_2, N_2 and O_2, employed by food and beverage industries. The concentrations of 23 selected elements, analysed by inductively coupled plasma mass spectrometry, in the three food gases collected from steel cylinders after a storage period of 50 days, were re-calculated considering (a) the initial concentrations (i.e. the concentrations of these elements in food gases before being packaged in carbon steel cylinders) and (b) a migration process of 5 years that proceeds in time following a linear trend.

Computed data were compared with the limit concentrations for mineral waters (CEE/CEEA/CE no. 83, 03-11-1998; D.Lgs no. 3, 2001; D.M. 29-12-2003), considering that the quantity of CO_2 commonly added to 1 L of mineral water is 5 g. Although no reference values indicating the concentration limits of metal contaminants in food gases are currently promulgated, the results of this comparison have evidenced that the highest concentrations of the most abundant elements among those selected for the test, i.e. Al, Cd, Cr, Cu, Fe, Mn, Ni and Pb, are up to 4 orders of magnitude lower that the previously cited limits. This suggests that the effects of migration of contaminants from carbon steel cylinders do not have a significant influence on the quality of food gases, independently on the type of food gas and carbon steel composition.
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KEY WORDS: migration process; food gases; packaging material; metal elements; carbon steel

INTRODUCTION

Recent European regulations (E.C. no. 1935/2004 and E.C. no. 2023/2006) impose controls of possible effects related to migration processes of contaminants from packages, including carbon steel cylinders, to *food gases*, which can be defined as those gases that are utilized by food and beverage industries for different applications, such as food preservation, ripening, spoilage prevention, freezing, chilling and carbonation. These regulations states that all materials and products in contact with food should be manufactured in compliance with the general and specific rules on guidelines for developing good manufacturing practices and standard operating procedures (http://www.haccpalliance.org/sub/food-safety/guifinal2.pdf). However, no laboratory tests have been provided to accomplish these requests in any stage of production, processing and distribution of food gases. A number of predictive mathematical models[1–10] and analytical strategies[11–14] were proposed to evaluate and quantify migrants from different types of polymeric packages to solid and liquid food, although much work is expected to be carried out for a correct estimation of the risk for human health related to the potential

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In 2014 was published the first CNR study about the migration process of potential metal contamination from Carbon Steel Cylinders to Food Gases.

- The result was no hazardous contamination in the food gases
- Currently this study support the authority request about the compatibility of our cylinders in contact with food gases

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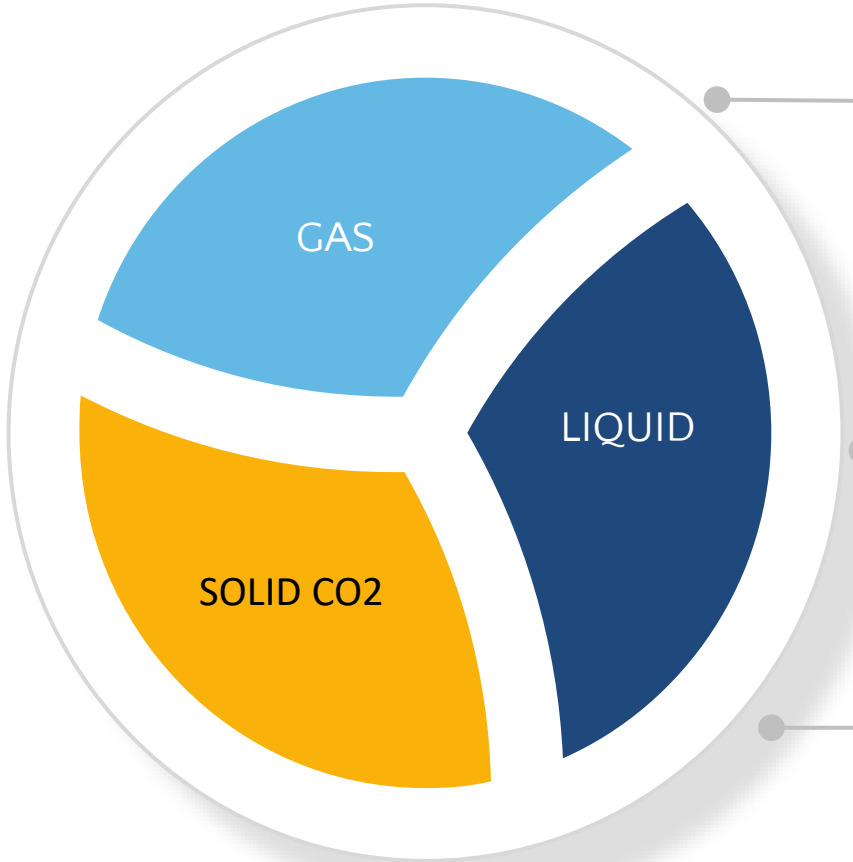
Associazione nazionale imprese gas tecnici, speciali e medicinali

National Research Council of Italy

Main Food Gases Applications



- Carbonation in Beverage
- MAP Packaging
- Blanketing/Inerting
- PET presurization
- Fat Hydrogenation
- Propelant agent

- Freezing/Chilling
- Dough cooling
- Food Transport

- Cooling
- Food Transport
- Cocktails

Ar

N_2

H_2

CO_2

O_2

N_2O

Food Gases applications

SOLGROUP

a breath of life

In summery

- The food gas additive are Food and the gas company that produce Food additive are food company
- Food gas producers are responsible for the safety of the food they produce and place on the market.
- It is of fundamental importance to comply with current food regulations when treating food gases.
- There are many applications in the food processing industry that used food gases

Thanks for the attention