

## The significance of structural components of lignocellulosic biomass on volatile organic compounds presence on biochar - a review

### Appendix 1

#### Explanations for column E in Table 1 (cited directly from REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL):

Aquatic Chronic 3 - Hazardous to the aquatic environment, chronic category 3 - 96 hr LC<sub>50</sub> (for fish) > 10 to ≤ 100 mg/l;

Acute Tox. 3 - Acute toxicity, category 3 - acute toxicity estimates (ATE) for gases 500 < ATE ≤ 2 500 ppm;

Acute Tox. 4 - Acute toxicity, category 4 - acute toxicity estimates (ATE) for gases 2 500 < ATE ≤ 20 000 ppm;

Carc. 1B - Carcinogenic category 1B - presumed to have carcinogenic potential for humans, classification is largely based on animal evidence;

Carc. 2 - Carcinogenic category 2 - Suspected human carcinogens. The placing of a substance in Category 2 is done based on evidence obtained from human and/or animal studies;

Eye Irrit. 2 - Serious eye damage/eye irritation, category 2 - if, when applied to the eye of an animal, a substance produces:

- at least in 2 of 3 tested animals, a positive response of:
  - corneal opacity ≥ 1 and/or
  - iritis ≥ 1, and/or
  - conjunctival redness ≥ 2 and/or
  - conjunctival oedema (chemosis) ≥ 2
- calculated as the mean scores following grading at 24, 48 and 72 hours after installation of the test material, and which fully reverses within an observation period of 21 days; Flam. Liq. 1 - Flammable liquid, category 1 with a flash point < 23 °C and initial boiling point ≤ 35 °C;

Flam. Liq. 2 - Flammable liquid, category 3 with a flash point < 23 °C and initial boiling point > 35 °C;

Flam. Liq. 3 - Flammable liquid, category 3 with a flash point ≥ 23 °C and ≤ 60 °C;

Muta. 2 - Germ cell mutagenicity category 2 - Substances which cause concern for humans owing to the possibility that they may induce heritable mutations in the germ cells of humans.

The classification in Category 2 is based on:

- positive evidence obtained from experiments in mammals and/or in some cases from in vitro experiments, obtained from:
- somatic cell mutagenicity tests in vivo, in mammals; or
- other in vivo somatic cell genotoxicity tests which are supported by positive results from in vitro mutagenicity assays;

Skin Corr. 1A - Skin corrosive category 1A, when the concentration of the ingredient is ≥ 1 %, Corrosive in > 1 of 3 animals – Exposure ≤ 3 minutes, Observation ≤ 1 hour;

Skin Corr. 1B - Skin corrosive category 1B, when the concentration of the ingredient is ≥ 1 %; Corrosive in > 1 of 3 animals – Exposure > 3 minutes - ≤ 1 hour, Observation ≤ 14 days;

Skin Irrit. 2 - Skin irritation category 2, when the concentration of the ingredient is ≥ 3 %;

STOT RE 2 - Specific target organ toxicity — repeated exposure, category 2 - Substances that, based on evidence from studies in experimental animals can be presumed to have the potential to be harmful to human health following repeated exposure;

STOT SE 1 - Specific target organ toxicity — single exposure, category 1 - Substances that have produced significant toxicity in humans or that, based on evidence from studies in

experimental animals, can be presumed to have the potential to produce significant toxicity in humans following a single exposure;

STOT SE 3 - Specific target organ toxicity — single exposure, category 3 - Transient target organ effects. This category only includes narcotic effects and respiratory tract irritation. These are effects which adversely alter human function for a short duration after exposure and from which humans may recover in a reasonable period without leaving significant alteration of structure or function.

**Explanations for column F in Table 1 (cited directly from REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL):**

H301 - Toxic if swallowed;

H302 - Harmful if swallowed;

H311: Toxic in contact with skin;

H312 - Harmful in contact with skin;

H314 - Causes severe skin burns and eye damage;

H315 - Causes skin irritation;

H319 - Causes serious eye irritation;

H224 - Extremely flammable liquid and vapour;

H225 - Highly flammable liquid and vapour

H226 - Flammable liquid and vapour;

H331 - Toxic if inhaled;

H332 - Harmful if inhaled;

H335 - May cause respiratory irritation;

H341 - Suspected of causing genetic defects (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);

H350 - May cause cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);

H351 - Suspected of causing cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);

H370 - Causes damage to organs (or state all organs affected, if known) (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);

H373 - May cause damage to organs (state all organs affected, if known) through prolonged or repeated exposure (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);

H412 - Harmful to aquatic life with long-lasting effects.

## Appendix 2

### Explanations for column D in Table 2 (cited directly from REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL):

Aquatic Acute 1 - Hazardous to the aquatic environment, acute category 1 - 96 hr LC<sub>50</sub> (for fish) ≤ 1 mg/l;

Aquatic Chronic 1 - Hazardous to the aquatic environment, chronic category 1 - 96 hr LC<sub>50</sub> (for fish) ≤ 1 mg/l;

Aquatic Chronic 2 - Hazardous to the aquatic environment, chronic category 2 - 96 hr LC<sub>50</sub> (for fish) > 1 to ≤ 10 mg/l;

Acute Tox. 1 - Acute toxicity, category 1 - acute toxicity estimates (ATE) for gases ATE ≤ 100 ppm;

Acute Tox. 2 - Acute toxicity, category 2 - acute toxicity estimates (ATE) for gases 100 < ATE ≤ 500 ppm;

Acute Tox. 3 - Acute toxicity, category 3 - acute toxicity estimates (ATE) for gases 500 < ATE ≤ 2 500 ppm;

Acute Tox. 4 - Acute toxicity, category 4 - acute toxicity estimates (ATE) for gases 2 500 < ATE ≤ 20 000 ppm;

Asp. Tox. 1 - Aspiration hazard, category 1 - Substances known to cause human aspiration toxicity hazards or to be regarded as if they cause human aspiration toxicity hazard. A substance is classified in Category 1: (a) based on reliable and good-quality human evidence or (b) if it is a hydrocarbon and has a kinematic viscosity of 20,5 mm<sup>2</sup>/s or less, measured at 40 °C;

Carc. 1A - Carcinogenic category 1A - known to have carcinogenic potential for humans, classification is largely based on human evidence;

Carc. 1B - Carcinogenic category 1B - presumed to have carcinogenic potential for humans, classification is largely based on animal evidence;

Carc. 2 - Carcinogenic category 2 - Suspected human carcinogens. The placing of a substance in Category 2 is done based on evidence obtained from human and/or animal studies;

Eye Irrit. 2 - Serious eye damage/eye irritation, category 2 - if, when applied to the eye of an animal, a substance produces:

- at least in 2 of 3 tested animals, a positive response of:
  - corneal opacity ≥ 1 and/or
  - iritis ≥ 1, and/or
  - conjunctival redness ≥ 2 and/or
  - conjunctival oedema (chemosis) ≥ 2
- calculated as the mean scores following grading at 24, 48 and 72 hours after installation of the test material, and which fully reverses within an observation period of 21 days; Flam. Gas 1 - Flammable gas, category 1 which at 20 °C and a standard pressure of 101,3 kPa: (a) are ignitable when in a mixture of 13 % or less by volume in the air; or (b) have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit;

Flam. Liq. 2 - Flammable liquid, category 3 with a flash point < 23 °C and initial boiling point > 35 °C;

Flam. Liq. 3 - Flammable liquid, category 3 with a flash point ≥ 23 °C and ≤ 60 °C;

Muta. 1B - Germ cell mutagenicity category 1B - The classification in Category 1B is based on: positive result(s) from in vivo heritable germ cell mutagenicity tests in mammals; or positive result(s) from in vivo somatic cell mutagenicity tests in mammals, in combination with some evidence that the substance has potential to cause mutations to germ cells. It is possible to derive this supporting evidence from mutagenicity/genotoxicity tests in germ cells

in vivo, or by demonstrating the ability of the substance or its metabolite(s) to interact with the genetic material of germ cells; or positive results from tests showing mutagenic effects in the germ cells of humans, without demonstration of transmission to progeny; for example, an increase in the frequency of aneuploidy in sperm cells of exposed people;

Muta. 2 - Germ cell mutagenicity category 2 - Substances which cause concern for humans owing to the possibility that they may induce heritable mutations in the germ cells of humans.

The classification in Category 2 is based on:

- positive evidence obtained from experiments in mammals and/or in some cases from in vitro experiments, obtained from:
- somatic cell mutagenicity tests in vivo, in mammals; or
- other in vivo somatic cell genotoxicity tests which are supported by positive results from in vitro mutagenicity assays;

Ozone - Hazardous to the ozone layer;

Press. Gas - Gases under pressure;

Repr. 2 - Reproductive toxicity, category 2 - Suspected human reproductive toxicant;

Skin Irrit. 2 - Skin irritation category 2, when the concentration of the ingredient is  $\geq 3\%$ ;

STOT RE 1 - Specific target organ toxicity — repeated exposure, category 1 - Substances that have produced significant toxicity in humans or that, based on evidence from studies in experimental animals, can be presumed to have the potential to produce significant toxicity in humans following repeated exposure;

STOT RE 2 - Specific target organ toxicity — repeated exposure, category 2 - Substances that, based on evidence from studies in experimental animals can be presumed to have the potential to be harmful to human health following repeated exposure;

STOT SE 1 - Specific target organ toxicity — single exposure, category 1 - Substances that have produced significant toxicity in humans or that, based on evidence from studies in experimental animals, can be presumed to have the potential to produce significant toxicity in humans following a single exposure;

STOT SE 3 - Specific target organ toxicity — single exposure, category 3 - Transient target organ effects. This category only includes narcotic effects and respiratory tract irritation. These are effects which adversely alter human function for a short duration after exposure and from which humans may recover in a reasonable period without leaving significant alteration of structure or function.

**Explanations for column E in Table 2 (cited directly from REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL):**

EUH059: Hazardous to the Ozone Layer;

H220 - Extremely flammable gas;

H301 - Toxic if swallowed;

H302 - Harmful if swallowed;

H304 - May be fatal if swallowed and enters airways;

H310 - Fatal in contact with skin;

H311 - Toxic in contact with skin;

H312 - Harmful in contact with skin;

H315 - Causes skin irritation;

H319 - Causes serious eye irritation;

H224 - Extremely flammable liquid and vapour;

H225 - Highly flammable liquid and vapour

H226 - Flammable liquid and vapour;

H330 - Fatal if inhaled;

H331 - Toxic if inhaled;

H332 - Harmful if inhaled;

H335 - May cause respiratory irritation;  
H336 - May cause drowsiness or dizziness;  
H340 - May cause genetic defects (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);  
H341 - Suspected of causing genetic defects (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);  
H350 - May cause cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);  
H351 - Suspected of causing cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);  
H361d - Suspected of damaging the unborn child;  
H361f - Suspected of damaging fertility;  
H370 - Causes damage to organs (or state all organs affected, if known) (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);  
H372 - Causes damage to organs (state all organs affected, if known) through prolonged or repeated exposure (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);  
H373 - May cause damage to organs (state all organs affected, if known) through prolonged or repeated exposure (state route of exposure if it is conclusively proven that no other routes of exposure cause the hazard);  
H400 - Very toxic to aquatic life;  
H410 - Very toxic to aquatic life with long-lasting effects;  
H411 - Toxic to aquatic life with long-lasting effects;  
H412 - Harmful to aquatic life with long-lasting effects.