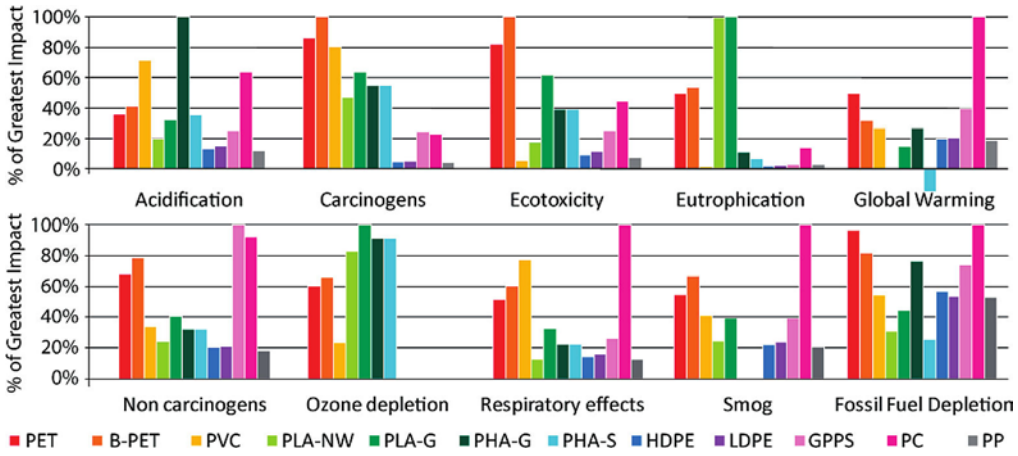
CORSO DI "ELEMENTI DI CHIMICA VERDE E SOSTENIBILE"

Scritto del 29 gennaio 2013 (II[a] Parte)

**1) From which natural precursors can be obtained the platform C-5 compounds? In which main compounds these derivatives can be converted in the context of an integrated biorefinery?

2) In the figure are reported the results of a life cycle assessment (LCA) of some polymers following the TRACI impact categories. Explain why profiles are so different, in particular as concern carcinogens, eutrophication, ozone reduction and fossil fuel reduction.



3) The following figure collects the impacts associated to life cycle analysis for 20 more common solvents. Identify the ones more volatiles, those which are more toxic for humans and those dangerous for the environment, indicating how their structure determine these effects.

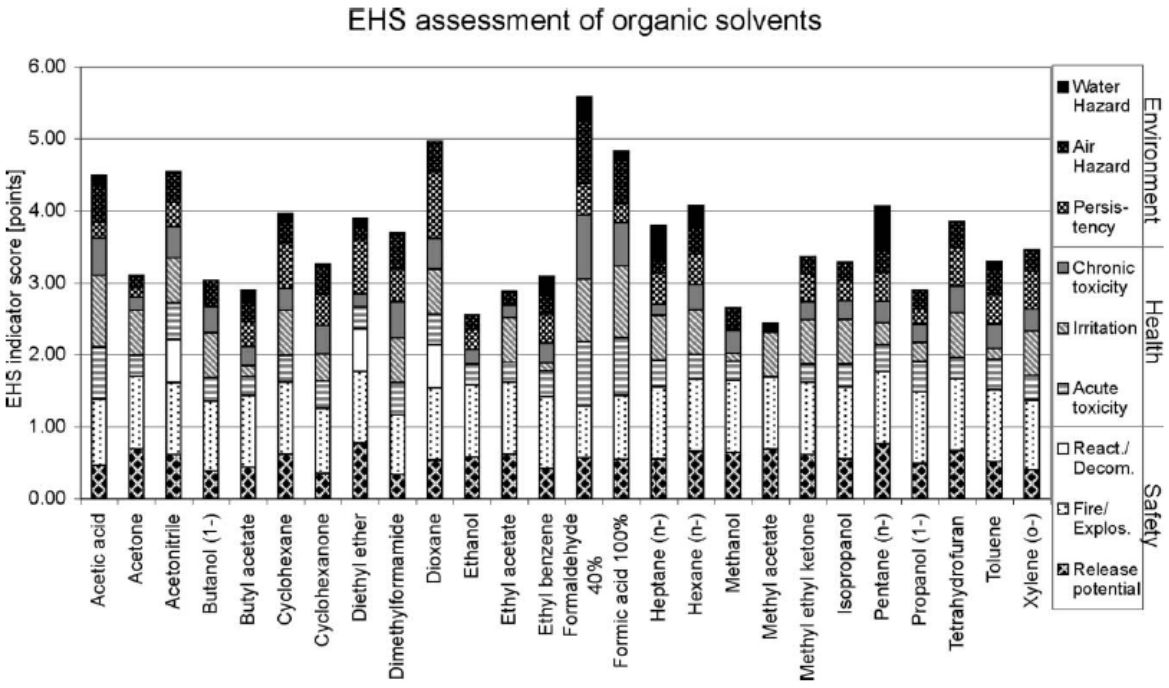


Fig. 2 Results of the EHS method for the 26 pure organic solvents (step (1) in the framework for the assessment of green solvents). The EHS result score is composed of environmental indicators (water and air hazard, persistency), as well as indicators for health (chronic and acute toxicity and irritation) and safety (reaction/decomposition, fire/explosion, release potential) hazards. The results were calculated using the EHS-Tool.[14]

4) PLA biopolymer and PHA natural polymer are compostable but they produce severe problems in recycling the thermoplastic PET polymer. Where come from this issue? Define correctly all three different types of the above mentioned polymers.

**5) Conversion of fructose into mannitol is catalyzed by the enzyme Mannitol Dehydrogenase which requires NADH as cofactor? Which is the meaning of various terms in the previous sentence and there are in normal chemical catalysis functional analogs of cofactors? Make some examples.

6) List the main strategies of process intensification in chemical field? Can process intensification be applied also in a non-chemical context? By using some examples evidence the results reached applying these strategies.

7) What is the hierarchy of waste prevention and disposal? Which are the main strategies adopted in this context?

*8) A company has suggested to substitute the solvent N-methylpyrrolidone (b.p. 202°C, LD50 250 mg/Kg, Log $K_{o/w}$ = - 0,026) with the compound cyclopentanone (b.p. 130°C, LD50 1850 mg/Kg, Log $K_{o/w}$ = 1,087). Which problems the proposed solution can solve and which instead are amplified? Could You propose a more reasonable alternative?

9) REACh regulations aim to substitute SVHC compounds with substances or technologies less dangerous? Which are the classes of SVHC compounds creating the higher concern and which strategies are proposed for its substitution?

10) Which is the aim of the process analytical technology (PAT) and how this integrates with the strategy to obtain a quality by design (QbD)? Make examples illustrating this integration in existent industrial processes.

*11) Which strategies are applied to reach safer conditions in a chemical process? In the case of firms in which relevant accident can occur, what is mandatory in the European law to be accomplished? Can be useful to have SIL 4 equipments?

**12) In one issue of Green Chemistry (June 2001) more than half of the articles had alternative solvents as the focal point of the research. The greener solvents included:

- ethyl lactate
- supercritical carbon dioxide
- solventless
- aqueous
- polyethylene glycol (PEG)

Briefly but critically describe the advantages and disadvantages of each of these from a Green Chemistry perspective.