University of Torino projects on the valorization of biowaste as a source of added value bio-based products

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Regione Piemonte (www.biochemenergy.it), Ministero delle Politiche Agricole e Forestali and Ministero dello Sviluppo Economico

Scope: valorization of residual biomasses as source of products for the chemical industry and agriculture

State of Art after 6 years research

1. Basic research completed
2. Most promising products' uses identified
3. On going:
   a) techno-economic evaluation of products and process;
   b) search of potential users for scaling up research results to industrial and commercial level:
   c) search of partners for further product-process development

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The Context

Fuels, chemicals and materials are indeed items that a Biorefinery should produce, as well as an Oil or a Carbon Refinery does. The biorefinery products can only be obtained by the concerted use of bio- and chemical technology. This presentation will show **the potential of biorefuse** from urban and agriculture origin **as source of value-added chemicals and materials**, and how these products could **integrate fuel production** to improve the economy of biofuel production processes.

Example

Biogas ← Lignocellulosic Wastes → Polysaccharides → Sugar → **Ethanol**

↓ ↓

Lignin Butandiol

↓ (*Unito Process*)

Chemicals ← Soluble Bio-Organics (SBO) → Fertilizers

↓

Biodegradable plastics

Burning lignin may not be the best option

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With reference to the issues addressed by this workshop, the project has been focused on

-The valorization of **biowastes** rather than of *dedicated crops*

-The use of **chemical technology** rather than *biochemical technology*

-The development of **low temperature** (40-60 °) ecofriendly (use of water, rather than organic solvents) processes to attain complete conversion of biowaste feed to valuable commercial products **without production of process effluents** requiring disposal treatments.

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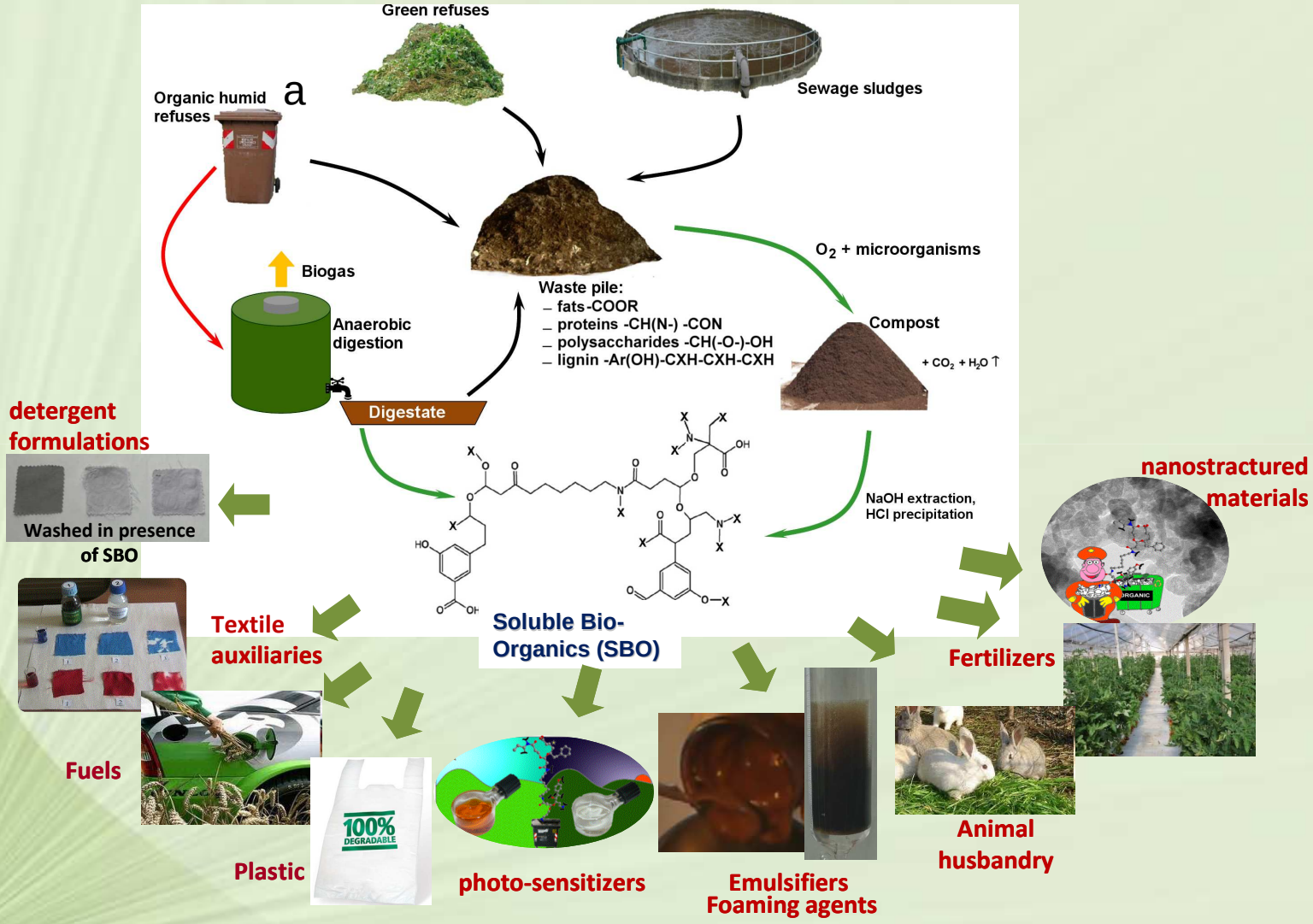
Projects Summary Showing Urban Biowastes and Derived Bio-based Products



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Very interesting; but

how to scale up these results from research to industrial/commercial level?

Three main conditions

1. The production process must be economically and environmentally viable; OK.
2. A sizable market exists; most promising fertilizers and emulsifiers
3. the product is accepted by the consumer; TO BE CONFIRMED

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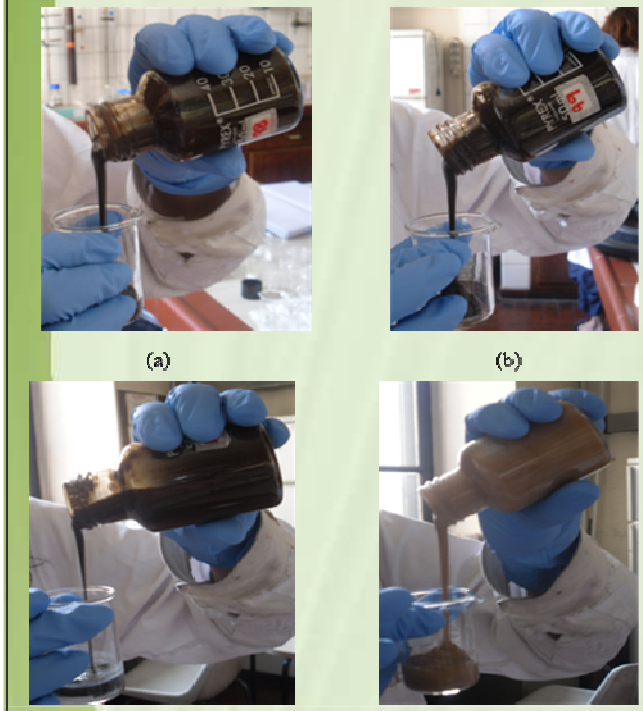

highly stable and ecofriendly **emulsions** of mineral oil in water containing 2.5 % SBO and 2.5 % anionic commercial surfactant **for metal working processes**

US market:
620 million liters per year of metal and **working fluids and automotive and industrial lubricants**.

Price of **4.5 € per liter would be very competitive**.

The SBO production cost has been estimated from 0.1 to 0.5 €/kg. Considering an emulsion containing 2.5 % **SBO, the cost contribution** of this additive in the finished emulsified product is ≤ **0.02 €/L**. The product could reasonable **be placed in the market at 1 €/kg.**

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For use in agriculture they can be used as such and yield excellent results: Enhancement of leaves chlorophyll content accompanied by

higher plant growth, **earlier fruit ripening** and **enhanced (up to 70-90 %) plant productivity in soil treated with only 140 kg ha^{-1} SBO.**

Rather low doses compared to 6-120 ton ha^{-1} for other organic fertilizers based on compost or animal manure**.**

On field trials performed for tomato, red pepper and maize cultivation

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Concluding Remarks

- Bio-wastes are a rich source of valuable products to use in a large number of industrial processes in place and/or in conjunction with synthetic chemicals.
- The results show that, in the worst case of 0.5 € kg^{-1} SBO production cost and 1 € kg^{-1} SBO sale value, the integrated plant selling biogas and SBO is likely to yield 78 higher earnings than the current plant selling biogas and compost.
- Expectations for a plant producing 2500 SBO tons/year:

- plant construction cost = € 1.000.000;

- net revenue € 2.250.000 by allocating the product in the agriculture market at 1 €/kg;

- will allow (i) to pay back in less than one year and (ii) to finance further product and process development

- Risk: Introducing a new product in the market

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Acnowledgements

These projects requiring multidisciplinary expertise have allowed
-to promote cooperation among many academic and research colleagues within the same University of Torino and
-to establish valuable contacts between the University of Torino and a wide number of italian and international academic and research institution and of industrial partners. Many of these are here to present their research results dealing with various biowastes, products and technologies connected to the waste valorization

I take this opportunity to thank the colleagues of the
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