Association des Amidonneries
de Céréales de l'Union Européenne

SUMMARY REPORT

Eco-profile of starch and related products

Based on a report by
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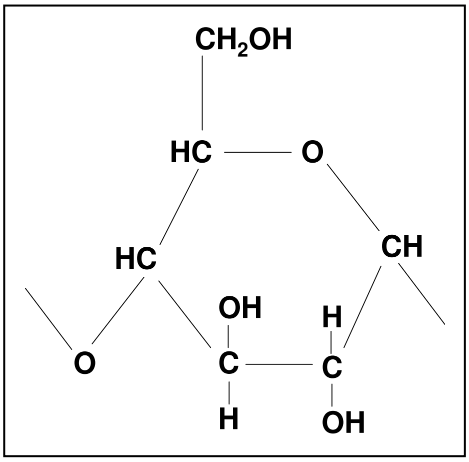
Introduction

The concept of sustainable development proposed by the United Nations has been a powerful driving force to focus global attention on the need to integrate environmental stewardship with economic development. AAC and its member companies recognise the importance for the industry to understand the environmental impact of its products during production, use, recovery and disposal.

AAC has therefore undertaken a detailed examination of the products manufactured by its members using the best data available and covering as wide a cross section of operators as possible

Starch and related products



Starches are carbohydrates which form the energy reserve in plants. They occur as discrete, partially crystalline granules and are present in all plants, being only second in abundance to cellulose, the major structural component of plants.

Starch consists, chemically, of repeated sequences of glycopyranosyl units. The number of repeat units varies from around 250 to 1000 and are linked in two ways: a linear structure (amylose) and a branched form (amylopectin). Most commercial starches contain 20-30% amylose and 70-80% amylopectin.

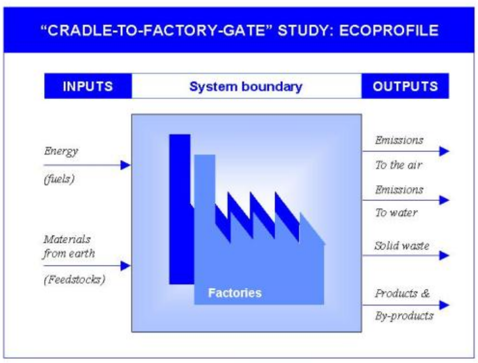
Manufacture of starch and related products

The main sources of commercial starch in Europe are maize, wheat and potatoes with smaller quantities being derived from rice, barley and tapioca. Starch is extracted by breaking down the plant structure and washing out the starch with water. Almost all of the non-starch components are valuable by-products and the economics of starch production relies on the salability of the by-products.

The extracted starch may be dried and sold as native starch. Alternatively, it can be subjected to further chemical and thermal treatment (modified starch) or reacted with enzymes to produce sweeteners (starch sugars).

Eco-profiles for environmental improvement

Eco-profiles are a ‘cradle-to-factory-gate’ summation of the consumption of energy and raw materials and of the solid, liquid and gaseous emissions during their manufacture when the starting materials are raw materials in the earth.



These eco-profiles are of immediate use for environmental improvements within individual companies.

In addition, eco-profiles of starch and starch products are intended for use by downstream industry, consultants and others who wish to evaluate the environmental performance of products using them. By providing information based on real current industrial practice, AAC aims to provide valid industrial data superior to all partial assessments and to the ‘guesswork’ available from third parties. The level of detail as well makes the data even more valuable to the evaluation of the environmental implications of the use of starch and starch products.

Methodology & data sources

The methodology used in the calculation of the eco-profiles follows the recommendations laid down in ISO 14040 and 14041 using information supplied by member companies of AAC. The data examined refer to the production of 3.7 million tonnes of native starch, 1.0 million tonnes of modified starch, 3.2 million tonnes of liquid starch sugars and 0.5 million tonnes of solid starch sugars.

Starch and energy

The cumulative gross energy required by the systems used to produce starch and related products when all inputs are traced back to the extraction of raw materials from the earth are shown in Table 1. The relative importance of the different contributions are shown in Table 2. Note that the most significant contributions are imported with the raw materials; only about 20% of the overall energy is due to the starch extraction process.

Table 1
Cumulative gross energies in MJ to produce 1 kg (dry mass) of starch and related products.

Product	Energy
Native starch	34
Modified starch	43
Liquid sweeteners	37
Solid sweeteners	46

Table 2
Relative energy contributions in the production of native starch

Contributor	%
Feedstock	57
Growing & harvesting	22
Steam	8
Electricity	8
Thermal fuels	3
Process chemicals	2

Starch and carbon dioxide

Current concerns about those gases which result in greenhouse warming cannot be ignored. The principal emission of greenhouse gases arise from the combustion of fossil fuels. In contrast, one of the main consumers of carbon dioxide is plant growing. Since the raw materials for starch and related products are maize, wheat and potatoes, their growth results in the consumption of carbon dioxide. When set against the relatively small amounts of carbon dioxide generated in the processing operations, the overall production of starch and related products show a net consumption of carbon dioxide (Table 3)

Table 3
Net consumption of CO_2 in kg by the systems used to produce 1 kg of starch and related products.

Product	CO_2 consumption
Native starch	2.9
Modified starch	2.2
Liquid sweeteners	2.5
Solid sweeteners	2.5

Starch and air emissions

The processes used in the manufacture of starch and related products are carried out in aqueous solution. There are no significant air emissions arising from the processes involved, apart from the usual emissions from the combustion of the relatively small quantities of fossil fuels.

Starch and water emissions

The principal cumulative water emissions per kg of product as shown in Table 4. All plants practise extensive waste-water treatment and all conform with local pollution regulations. The emissions of BOD, COD and suspended solids are similar in magnitude to those observed in most operations that process biological raw materials. The emissions of K^+, Na^+, Cl^- and $SO4^{--}$ arise from process chemicals.

Table 4
Principal cumulative water emissions in g/kg product, excluding agricultural emissions.

Emission	Native starch	Modified starch	Liquid Sweeteners	Solid sweeteners
COD	2.6	3.2	3.7	4.1
BOD	0.4	1.2	0.9	2.3
Suspended solids	0.7	2.5	0.4	0.5
Na+/K+	4.1	20.0	10.0	6.2
Cl-	0.7	9.0	1.5	3.4
SO4--	0.2	1.2	0.1	0.1

Starch and solid waste

Most of the solid waste generated in the production of starch and related products arises from the biological residue after processing. A significant proportion of this waste can be used directly as fertiliser and so the values can vary between 3 and 30 g per kg of product.

Outlook

To extend the “cradle-to-factory-gate” study to specific products, it is essential to select the correct raw materials and to combine their data in the correct ratio to produce a full “cradle-to-grave” life cycle. Only when this is done is it possible to carry out meaningful comparisons. Eco-profiles, such as this initiated by AAC, are essential building blocks in the construction of complete life-cycles.

It is important to note that it is meaningless to compare 1 kg of one material with 1 kg of a different material. Comparisons between different materials can only be made by looking at the complete life cycles of the materials and when they are used in applications which perform identical functions.

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