Tecnon OrbiChem

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# CHEMICAL BUSINESS FOCUS

## A MONTHLY ROUNDUP AND ANALYSIS OF THE KEY FACTORS SHAPING WORLD CHEMICAL MARKETS

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# BIO-MATERIALS & INTERMEDIATES

## INCLUDING BIO-BASED CHEMICALS, BIO-POLYMERS & THEIR PETROCHEMICAL EQUIVALENTS

**Ethylene/Polyethylene**
Braskem to expand sugarcane-based LDPE production capacity by 30 ktpa in 2014

**Monoethylene Glycol**
JBF Industries and Coca Cola in partnership to set up bio-MEG plant in Sao Paolo, Brazil by 2016

**Polyethylene Terephthalate**
Toyota Tsusho using bio-based PET from bio-MEG in its GLOBIO for Suntory water bottles from May 2013

**1,4 Butanediol**
BASF plans to build world-scale 1,4-BDO based on renewable feedstock using Genomatica process

**Polyamides**
Arkema acquires 25% stake in castor oil producer, Ihsedu Agrochem for bio-polyamide production

**Propylene Glycol**
Global Bio-Chem polyol chemical expansion in Xinglongshan depends on bio-MPG market performance

**Butanols**
AkzoNobel and Solvay partner on Solvay's Augeo™ line of renewable oxygenated solvents, including bio-butanol, bio-acetone and their derivatives for paints and coatings

**Epichlorohydrin**
AkzoNobel has partnered with Solvay in sourcing epoxy resins made with Solvay's glycerol-based epichlorohydrin (ECH)

**Succinic Acid**
Myriant successfully started commercial production of biobased succinic acid at its 14ktpa plant in Lake Providence, Louisiana, USA

**Fatty Acids**
Solazyme to start commercial production of feedstock algal oils for tailored high myristic and high oleic fatty acids

**Fatty Alcohols**
Wilmar's 150 ktpa fatty alcohol facility in Indonesia expected to start up in June

**Glycerol**
METabolic EXplorer forms marketing agreement for glycerol-based 1,3 propanediol (PDO)

**Polylactic Acid (PLA)**
US PLA producer, NatureWorks, chooses Cromex as Brazilian distributor for Ingeo® fibres and plastics

# PRICE MONITOR

## US PRICES

| | | *Mar-2013* | *Apr-2013* | *May-2013* | *28-Jun-2013* | | *28-Jun-2013* |
|---|---|---|---|---|---|---|---|
| | | *¢/lb* | *¢/lb* | *¢/lb* | *¢/lb* | | *$/ton* |
| **Ethylene** | Contract Monthly | 48.00 | N.A. | N.A. | N.A. | DDP | N.A. |
| **MEG** | Spot | 43.00 - 48.00 | 40.00 - 44.00 | 41.00 - 45.00 | 39.00 - 42.50 | FOB | 860 - 937 |
| | Bio-based | 57.0 - 59.0 | 54.0 - 55.0 | 55.0 - 56.0 | 53.0 - 53.5 | DDP | 1168 - 1179 |
| **Polyester** | Bottle Polymer | 98.5 - 101.5 | 93.0 - 95.5 | 93.0 - 95.5 | 92.5 - 95.0 | DDP | 2039 - 2094 |
| | Bottle Polymer Bio-based | 105.5 - 106.5 | 100.0 - 100.5 | 100.0 - 100.5 | 99.5 - 100.0 | DDP | 2194 - 2205 |
| **Adipic Acid** | Contract | 100 - 105 | 100 - 105 | 100 - 105 | 100 - 105 | DDP | 2205 - 2315 |
| **Monopropylene Glycol** | Industrial Grade Contract | 84.00 - 97.00 | 84.00 - 97.00 | 79.00 - 92.00 ‡ | 74.00 - 87.00 | EXW | 1631 - 1918 |
| **n-Butanol** | Export | 63.5 | 60.8 - 61.7 | 59.0 | N.A. | FOB | N.A. |
| **Epichlorohydrin** | Contract | 103 - 113 | 103 - 113 | 102 - 112 | 94 - 98 | DDP | 2072 - 2161 |
| **1,4-Butanediol** | Contract Quarterly | 144 - 154 | 141 - 154 | 141 - 154 | 141 - 154 | DDP | 3108 - 3395 |
| **Succinic Acid** | Contract | N.A. | N.A. | 113.0 | 113.0 | DDP | 2491 |
| | Bio-based | N.A. | N.A. | 113.0 | 113.0 | DDP | 2491 |
| | | *$/ton* | *$/ton* | *$/ton* | *$/ton* | | |
| **Fatty Acids (Bio-based)** | Stearic Acid Contract | N.A. | N.A. | 1250 - 1470 | N.A. | CFR | |
| | Oleic Acid Contract | N.A. | N.A. | 1740 - 1830 | N.A. | CFR | |
| **Fatty Alcohols (Bio-based)** | C12-C15 Contract | N.A. | N.A. | 1900 | N.A. | CFR | |
| | C16-C18 Contract | N.A. | N.A. | 1900 | N.A. | CFR | |
| **Glycerol (Bio-based)** | Refined Glycerine Contract | N.A. | N.A. | 1000 | N.A. | CFR | |
| | Crude Glycerine Spot | N.A. | N.A. | 200 - 300 | N.A. | CFR | |

N.A. = Not Available ‡ = Revised

Current one US dollar equivalent (28-Jun-2013)
€: 0.769 £: 0.659 (1/1.517) Yen: 99.3 NT$: 29.97 Won: 1142.05 Rmb: 6.14 Rs: 59.43
Current one € equivalent (28-Jun-2013)
US$: 1.300 £: 0.857 (1/1.167) Yen: 129.2

Information contained in this report is obtained from sources believed to be reliable, however no responsibility nor liability will be accepted by Tecnon OrbiChem for commercial decisions claimed to have been based on the content of the report.

# PRICE MONITOR

## WEST EUROPE PRICES

| | | *Mar-2013* €/ton | *Apr-2013* €/ton | *May-2013* €/ton | *28-Jun-2013* €/ton | | *28-Jun-2013* $/ton |
|---|---|---|---|---|---|---|---|
| **Ethylene** | Contract Monthly | 1325 | 1265 | 1165 | 1170 | DDP | 1521 |
| **MEG** | Spot T2 | 880 - 920 | 810 - 830 | 790 - 820 | 780 - 820 | FOB | 1014 - 1066 |
| | Bio-based | 1080 - 1120 | 1010 - 1030 | 920 - 990 | 980 - 1020 | FOB | 1274 - 1326 |
| **Polyester** | Bottle Polymer Northern Europe | 1422 - 1437 ‡ | 1377 - 1392 ‡ | 1361 - 1376 ‡ | 1340 - 1355 † | DDP | 1743 - 1762 |
| | Bottle Polymer Bio-based | 1522 - 1537 | 1477 - 1492 | 1461 - 1476 | 1440 - 1455 | DDP | 1873 - 1892 |
| **Adipic Acid** | New Contract | 1680 - 1700 | 1680 - 1720 | 1680 - 1720 | 1680 - 1720 † | DDP | 2185 - 2237 |
| **Monopropylene Glycol** | Industrial Grade Contract | 1240 - 1300 | 1220 - 1280 | 1180 - 1220 | 1160 - 1200 | DDP | 1508 - 1560 |
| **n-Butanol** | Export Asia | N.A. | 1036 | N.A. | N.A. | FOB | N.A. |
| **Epichlorohydrin** | Contract | 1745 - 1760 | 1820 - 1830 | 1780 - 1800 | 1745 - 1765 | DDP | 2269 - 2295 |
| **1,4-Butanediol** | Contract Quarterly | 2030 - 2150 | 2045 - 2150 | 2045 - 2150 | 2045 - 2150 | DDP | 2659 - 2796 |
| **Succinic Acid** | Contract | N.A. | N.A. | 1900 | N.A. | DDP | N.A. |
| | Bio-based | N.A. | N.A. | 1900 | N.A. | DDP | N.A. |
| **Fatty Acids (Bio-based)** | Stearic Acid Contract | N.A. | N.A. | 950 | N.A. | CFR | N.A. |
| | Oleic Acid Contract | N.A. | N.A. | 1000 | N.A. | CFR | N.A. |
| **Fatty Alcohols (Bio-based)** | C12-C14 Contract | N.A. | N.A. | 1540 | N.A. | CFR | N.A. |
| **Glycerol (Bio-based)** | Refined Glycerine Contract | N.A. | N.A. | 570 - 650 | N.A. | CFR | N.A. |

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# PRICE MONITOR

## ASIA PRICES

| | | *Mar-2013* *$/ton* | *Apr-2013* *$/ton* | *May-2013* *$/ton* | *28-Jun-2013* *$/ton* | |
|---|---|---|---|---|---|---|
| **Ethylene** | Import East Asia | 1260 - 1290 | 1170 - 1190 | 1190 - 1220 | 1250 - 1280 | CFR |
| **MEG** | Import Spot | 1040 - 1090 | 980 - 1020 | 980 - 1020 | 950 | CFR |
| | Bio-based | N.A. | N.A. | N.A. | N.A. | CIF |
| **Polyester** | Bottle Polymer China Export | 1440 - 1470 | 1390 - 1410 | 1400 - 1420 | 1380 - 1390 | FOB |
| | Bottle Polymer Bio-based | 1565 - 1595 | 1515 - 1535 | 1525 - 1545 | 1505 - 1515 | CIF |
| **Adipic Acid** | Import Contract, High Quality | 1950 | 1950 | 1880 - 1950 | 1800 - 1900 | CFR |
| **n-Butanol** | Import | 1460 - 1500 | 1440 - 1460 | 1310 - 1380 | 1220 - 1250 | CFR |
| **Epichlorohydrin** | Spot | 1450 - 1500 | 1450 - 1500 | 1550 - 1600 | 1500 - 1580 | CFR |
| | Bio-based | N.A. | N.A. | 1550 - 1600 | N.A. | CFR |
| **1,4-Butanediol** | China | 2000 - 3000 | 1920 - 3000 | 1880 - 3000 | 1850 - 3000 | CFR |
| **Succinic Acid** | Contract | N.A. | N.A. | 2500 | 2500 | FOB |
| **Fatty Acids (Bio-based)** | Lauric Acid Contract, Southeast Asia | N.A. | N.A. | 1400 - 1450 | N.A. | FOB |
| | Oleic Acid Contract, Southeast Asia | N.A. | N.A. | 1450 | N.A. | FOB |
| | Stearic Acid Contract, Southeast Asia | N.A. | N.A. | 950 | N.A. | FOB |
| **Fatty Alcohols (Bio-based)** | C12-C14 Contract, Southeast Asia | N.A. | N.A. | 1475 | N.A. | FOB |
| | C16-C18 Contract, Southeast Asia | N.A. | N.A. | 1385 | N.A. | FOB |
| **Glycerol (Bio-based)** | Refined Glycerine Contract, Southeast Asia | N.A. | N.A. | 885 - 910 | N.A. | FOB |
| | Crude Glycerine Spot, Southeast Asia | N.A. | N.A. | 400 | N.A. | FOB |

N.A. = Not Available

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# COMPANY NEWS

## North America

**Amyris**, a US-based producer of farnesene, announced a multi-year collaboration with International Flavors & Fragrances (IFF) to develop and commercialize a specific set of renewable fragrance ingredients. IFF will have exclusive rights to the renewable-based fragrance ingredients in the flavours and fragrances (F&F) applications while Amyris will have exclusive rights in other fields of application. The companies did not disclose specific names of the F&F chemicals developed using Amyris's farnesene-based molecules.

**BioAmber** has partnered with chemical distributor, Brenntag, for the distribution of BioAmber's Bio-SA bio-based succinic acid and derivatives, including bio-based 1,4-butanediol (BDO) in the Americas. BioAmber has also partnered with distributor IMCD Group targeting markets in the Benelux, France, Iberia, Germany, Poland, South East Europe, Switzerland, the UK, and Ireland.

**Cereplast**, a starch-based plastic producer, has restructured its global operation by closing its offices in El Segundo, California, and relocating its corporate headquarters to Seymour, Indiana. The company is also closing its offices in Bonen, Germany, and moving its European headquarters to its office in Milan, Italy. The re-structuring will reduce the company's annual operating expenses by $600k-$800k per year.

**Croda International Plc** has completed the acquisition of the specialty products business of Arizona Chemical, based in Jacksonville, Florida. The acquired products include naturally-derived polyamides with high bio-based content. No manufacturing assets were purchased as part of the transaction. Croda will relocate the products to its Mevisa manufacturing site in Spain and the company plans to re-launch the products with new trade names.

**Myriant** has scaled up and commercially-produced bio- succinic acid at ThyssenKrupp Uhde's biotech commercial validation facility in Leuna, Germany. The production reportedly meets targets for commercial yield and product quality. Myriant has been producing bio-succinic acid in Leuna since April 2013 and has achieved a 3m lbs/year (1360 tons/year) operating rate at the plant. Myriant and ThyssenKrupp Uhde have worked together since 2009 with the goal of making their bio-succinic acid process cost-competitive and to produce the highest purity product at commercial-scale. Future Myriant plants are expected to be built by Uhde.

**NatureWorks and Calysta Energy** have collaborated to research and develop world-scale production process for fermenting methane into lactic acid, the building block for NatureWorks' Ingeo™ polylactic acid (PLA) resins. The companies expect price for Ingeo™ PLA resins will further decline if the collaboration results in a successful commercialization of the technology.

**Synthesis Energy Systems (SES)**, a Houston, US-based energy and gasification technology company, has developed a process that integrates its gasification technology with renewable waste resources and natural gas to cost-effectively produce chemicals such as methanol and methanol derivatives. SES believes this new approach has primary applicability near large metropolitan areas where it can enable economical production of chemicals, at nominal quantities of 500,000 tons per year. It potentially offers a long-term solution for the utilization of ever-increasing amounts of municipal waste generated worldwide.

## Europe

**AkzoNobel and Solvay** have signed an agreement to establish a partnership for the use of Solvay's Augeo™ line of renewable oxygenated solvents such as bio-butanol, bio-acetone and their derivatives, within AkzoNobel's formulations of paints and coatings. All the products under the Augeo™ line are developed entirely in Brazil, targeting both local and global markets.

Under the deal, AkzoNobel is expected to get bio-based solvent volumes of up to 10,000 tons/year by 2017. The project is expected to take over two years and both companies will mobilize specific resources starting Q2 2013.

**AVA Biochem**, a Switzerland-based renewable chemicals developer, has begun operation of its 20 tpy industrial plant production of 5-hydroxymethylfurfural (5-HMF) in Muttenz, Switzerland. Until now, there was no industrial process worldwide for the production of this platform chemical. The company uses biomass such as woodchips for feedstock. AVA Biochem intends to deliver the product to industrial and research customers around the globe.

**CSM**, the co-owner of bio-succinic acid producer Succinity GmbH, has changed its name to Corbion. The company's biochemical business focuses on PLA, bio-succinic acid, and lactic acid derivatives. It expects sizeable investments in lactic acid capacity expansion in 2014-2015. Succinity is also expected to expand its bio-succinic acid capacity to between 50 ktpy and 100 ktpy by 2015-2017, if its 10 ktpy pilot facility in Spain is successful as it starts operation by the end of 2013.

**Global Bioenergies**, based in France, has started scaling up its 42-litre laboratory pilot production of bio-isobutene to a 500-litre fermenter, which represents a yearly production capacity of 10 tons. The industrial pilot facility will be installed in Bazancourt-Pomacle biorefinery near ARD's agro-industrial complex. The facility will include a purification unit installed downstream of the fermenter, which will allow the production of intermediate-purity isobutene batches.

The isobutene will be then transferred to French specialty chemical firm, Arkema, for its own research. Arkema will also develop an oxidation process adapted to the specifications of renewable products obtained by fermentation in collaboration with two CNRS (Centre National de la Recherche Scientifique) laboratories; IRCELYON and UCCS. The government of France is contributing a €5.2M ($6.74m) three-year grant to the isobutene industrialization program, of which €4 million will go to Global Bioenergies.

**KNN** in Groningen, Netherlands, and **Anoxkaldnes** in Lund, Sweden, both research technology firms, have partnered towards production of polyhydroxyalkanoate (PHA) resin production in northern Netherlands using industrial and municipal wastewater for feedstock.

**METabolic EXplorer (Metex)**, based in France, has signed two letters of intent with two international manufacturers to sell its bio-based 1,3 propanediol (PDO) under the brand name,TEXEROL™. The two manufacturers' commitments will absorb more than half of the company's future 50 ktpa commercial capacity planned for Malaysia. The facility is expected to have an initial output of 8 ktpa using crude glycerol as feedstock.

Metex has also announced that it has produced its first samples of butyric acid, a by-product of the manufacture of bio-PDO, at the laboratory stage. The company, meanwhile, has discontinued its development of glycolic acid and butanol.

**Novamont**, a bioplastic company based in Italy, launched its fourth generation Mater-Bi® biodegradable and compostable bioplastic line that will use vegetable oil-based azelaic acid and sugar-based 1,4 butanediol (BDO) for feedstock. The new materials can be used in applications such as flexible and rigid films, coatings, printing, extrusion and thermoforming.

**Roquette**, a starch-based derivatives producer, has restarted its production unit for its DISORBENE® sorbitol-based polymer clarifiers in Lestrem, France. The agents reduce haze in polypropylene and give clarity and transparency to products such as food trays, yogurt cups and storage boxes. Roquette has also launched its third generation sorbitol-based clarifier DISORBENE® 3.

**UPM**, a Finnish pulp and paper company has partnered with US cellulosic sugar developer Renmatix to convert woody biomass into low-cost sugar intermediates for subsequent downstream processing into biochemicals. Renmatix's Plantrose™ process employs water at very high temperatures and pressures to breakdown biomass through supercritical hydrolysis. The companies are still in the mill-scale concept development stage and has not disclosed specific plans for building a renewable chemicals facility.

## Asia

**PTT Global Chemical (PTTGC)** of Thailand announced the formation of a joint venture company called Auria BioChemical Co. Ltd. with US bio-succinic acid producer Myriant. The goal of the joint venture is to conduct research and development of bio-based chemicals and to eventually invest in a commercial scale production plant in Southeast Asia. Auria BioChemical has been registered in Thailand with a capital of 90 million Baht ($3 million). PTTGC holds 54% of the total share of the company, with an investment of 48.6m Baht.

**Cardia Bioplastics** has partnered with the University Of Sydney, Australia, to create a more cost-effective and higher-purity polypropylene carbonate polymers (PPC), a class of biodegradable polymers that use carbon dioxide for feedstock. The plastics being developed will have a broad range of use, from fully recyclable shopping bags to biodegradable medical implants. The research is also focusing on developing large-scale solvent-free technologies that reduce the levels of heavy metal used in PPC.

## PRODUCT NEWS

**Addivant USA LLC** has started commercialization of its POLYBOND® 6009 and POLYBOND® 6029, the company's first plant-derived polymer modifiers, developed to act as coupling agents or compatibilizers in formulations where high renewable content raw materials are desired. Biopolymers incorporating the new POLYBOND® products reportedly enhanced mechanical and physical properties resulting from the chemical coupling of the polar and non-polar components of the formulation.

**Axiall Corporation** based in Atlanta, Georgia, USA, has introduced bio-based flexible vinyl plasticizers under the trade name Aspire™, reportedly the market's first phthalate-free, bio-based compounds offering improved performance at a price that is equal to its traditional non-sustainable counterparts. The compounds have greater than 25% renewable content and meet the US Department of Agriculture's (USDA) BioPreferred Program requirements.

**BASF** has launched new variants to its range of compostable and partially bio-based plastic Ecovio®. The Ecovio® T2308 is available for the processing method of thermoforming, and Ecovio® IS1335 grade is available for injection molding. Ecovio® is made from the combination of either starch-based or polylactic acid-based resins and BASF's biodegradable petroleum-based aliphatic-aromatic co polyester PBAT (polybutyl adipic terephthalic acid) under the brand Ecoflex®.

**Cereplast**, a US bioplastic producer, has launched a new bioplastic resin grade Biopropylene® A150D, an injection molding grade manufactured with 51% post-industrial algae biomass. The bioplastic resins is commercially available starting Q2 2013. Biopropylene® A150D can be processed on existing conventional electric and hydraulic reciprocating screw injection molding machines, and is recommended for thin wall injection molding applications. Cereplast's subsidiary Algaeplast is expected to develop a 100% algae-based plastic within the next three years.

**Far Eastern New Century (FENC) Corporation**, a Taiwan-based polyester producer, has successfully made high-performance fibers and clothing under their line of functionalized apparel such as TopCool™ containing up to 50% biobased polymer using Genomatica's bio-1,4 butanediol (BDO). FENC is currently in discussion with customers for these high bio-content fibers and expects to source biobased BDO from one of Genomatica's licensed producers.


**Plantic Technologies**, a Germany-based bioplastic company, has developed a renewable and recyclable ultra-high barrier packaging under the tradename Plantic eco Plastic™ R. The new material combines PET and Plantic's biodegradable film that provides materials with ultra-high gas barrier properties and is made from up to 60% renewable materials content.

**Materis**, a leading France-based paint producer, and RPC Superfos, the biggest packaging provider for Materis in France have launched a paint product under the brand GEODE where both the pail and the paint are plant-based. The biobased pail was made from starch-based thermoplastic resins called Gaialene made by France-based Roquette.

**SC Johnson**, a US-based consumer products company, has launched its Ziploc® Brand Compostable Bags such as sandwich bags, food storage bags and food scrap bags that are designed for use in commercial composting facilities that accept food scraps and compostable bags. The compostable bags are not suitable for backyard composting because they are less efficient than commercial composting facilities.

**Takeda Pharmaceutical Company Limited** of Japan will start using bio-polyethylene (Bio-PE) bottles as the primary packaging container for its hypertension treatment product, Azilva® (500-tablets, bulk packaging). The Bio-PE is made by Braskem using sugarcane feedstock. The Bio-PE bottles have been tested for critical functionalities such as moisture permeability and shock resistance, as well as their potential impact on the quality of tablets.

**Tetra Pak**, a global packaging company, has launched LightCap 30, a high-density polyethylene (HDPE) cap made from sugarcane, which is now being used on its Tetra Brik® Aseptic Edge for range of products. Norwegian dairy producer TINE is the first brand in Europe to use the biobased caps on its Piano vanilla sauce, TINE iced coffee, iced tea and chocolate milk packaged in the Tetra Brik® Aseptic Edge.

# ETHYLENE AND POLYETHYLENE

## North America - Petrochemical

There has been no settlement yet of contract prices in the US for April, May and June. It now appears likely that a three-month settlement will be agreed early in July. The tragic accident at the Williams Geismar site on 13 June and the subsequent fall in ethane prices have dominated the market in June. Ethane fell by 3 c/gal to around 23 cents, recovering later to 24-25 c/gal. Spot ethylene rose by around 10 c/lb to 62-63 c/lb. By 26 June it had fallen back to 57 c/lb. Shell at Norco, Dow No 7 at Freeport and ChevronPhillips at Port Arthur all re-started late in the month bringing 1.97 million tpa of ethylene capacity back on stream..

## South America - Bio-based

International packaging company Tetra Pak has signed a supply agreement with Braskem for its sugarcane-based low-density polyethylene (LDPE), which will be used in all Tetra Pak packages produced in Brazil.

The biobased LDPE supply is scheduled to start during the first quarter of 2014 and will be used as a component of Tetra Pak's packages produced in Brazil. The packaging materials will have renewable-based components of up to 82%. Tetra Pak said about 13bn biobased packages will be produced in Brazil.

Braskem said the LDPE made from sugarcane has the same technical properties as LDPE made from fossil sources. Braskem biopolymers are marketed under the trademark I´m green™. The company announced last month that it is planning to expand its 200 ktpa bio-PE production in Rio Grande do Sul with a 30 ktpa line producing sugarcane-based LDPE. The biobased LDPE is expected to be available in the market starting January 2014.

Braskem recently announced that it will also start marketing PE caps for carbonated beverages in the second half of this year, and that the PE caps can also be made from Green PE.

Braskem has been producing sugarcane ethanol-based high-density polyethylene (HDPE) and linear low-density polyethylene (LLDPE) since September 2010 at its 200,000 ton/year Green PE plant in Rio Grande do Sul near Porto Alegre, Southern Brazil.

## West Europe - Petrochemical

The European contract for June was settled at an increase of €5/ton to €1170/ton ddp. Spot has been tighter in June with two major crackers down on turnaround – BPRP at Gelsenkirchen and BASF at Antwerp. Spot prices have increased relative to contract. Whereas last month numbers fell to as much as 25% below the contract level, prices in late June are in the region of €1000-1050/ton ddp, or 10-15% below contract. Spot prices at the coast are estimated to be about $1300/ton cif for imported material, not that there is very much available. On 25 June the BASF Antwerp cracker was reported to be producing on-spec material

## Asia - Petrochemical

Ethylene markets in Asia were quiet early in June and only started to pick up after the Chinese Dragon Boat holiday on the 12th. Spot prices ended May in the range of $1195-1220/ton cfr. A cargo was sold at $1195/ton cfr China for first half July loading. By the middle of the month the range had increased to $1200-1230/ton cfr. In Southeast Asia a cargo was reported sold at $1250/ton fob. By 20 June the range of prices had firmed to $1240-1270/ton because of stronger demand from China and spot numbers reached $1250-1280/ton by the 24th.

# MONOETHYLENE GLYCOL

## North America - Petrochemical

MEG demand is reported as being fair, but not as high as had been expected. One major supplier put this down to an increase in the imports of PET resin, most likely from Mexico. MEGlobal and Indorama both reduced their benchmark prices this month by 2.0 c/lb to give levels of 61.0-62.0 c/lb DDP.

This was not because of any fall in the ACP, which was actually rolled over, but as a reaction to global spot pricing and possibly a forewarning of the reduction to come on the July ACP. Supplies could still be snug, as Shell's Scotford plant is still on turnaround into early July.

## The Americas - Bio-based

Mexico and the US continue to import bio-MEG from India. It is unlikely that bio-MEG would be produced in North America, certainly it can not compete on a cost basis with new EO/EG capacity based on ethylene from ethane from shale gas exploitation. Imports can be expected to continue of either bio-MEG or part-bio-PET to meet the perceived consumer demand for bio-based (or in this case, partly-bio-based) plastics.

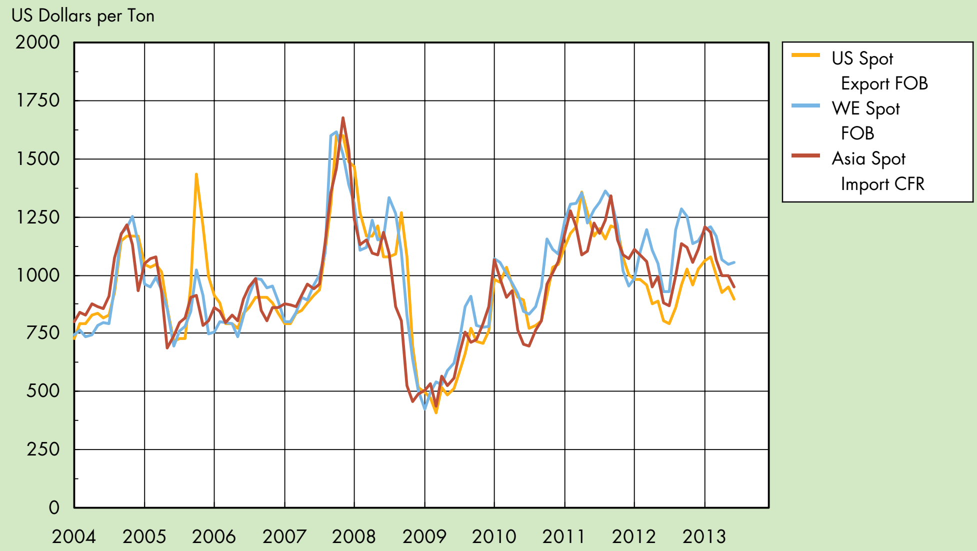
JBF Industries and Coca Cola have entered into a partnership to set up a bio MEG plant in Sao Paolo Brazil. The facility will be the world's largest bio-MEG unit at 500 ktpa and will use locally sourced sugarcane and sugarcane process waste to produce bio ethanol. The project is expected to come on stream by the end of 2015/beginning of 2016.

## West Europe - Petrochemical

The MEG contract price for May in Europe was settled at €965/ton ddp before discounts in late month. This was a drop of €55/ton. So far no agreement has been reached on the June level.

The spot market in Northern Europe is still fairly lax and price levels were being quoted around €760-770/ton FCA in early June. However, lower import volumes have produced some upward movement and spot prices are now quoted in the range €780-820/ton ddp.

**UNITED STATES, WEST EUROPE & ASIA MONOETHYLENE GLYCOL SPOT PRICES**




Source: Tecnon OrbiChem

### West Europe - Bio-based

Some volume of bio-MEG continues to be imported from India into Europe. This material is thought to be used in specialty PET material manufactured in the UK by Indorama for the European market. April contracts are understood to be settled at €1020/ton. Prices for bio-MEG are estimated around $250-350/ton higher than conventional MEG, although specific prices are difficult to confirm.

The May MEG market has been sluggish but there is hope that with improving weather conditions demand will pick up. The driver for the bio-based market will be a commitment to the environment through marketing (as in the case of Coca Cola). But price will depend largely on conventional MEG prices, to which a premium then applies.

### Asia - Petrochemical

Demand for MEG in China has shown no signs of improvement, quite the contrary, as it appears that it has actually dropped. This is because the period of high offtake anticipated from the polyester fibre industry for the autumn and winter seasons has now finished. Traders and distributors have been rushing to offload inventories ahead of a feared action by the Chinese government to curb speculation in the markets. This flurry of sales has caused import spot prices to move down from around $1025/ton cfr in late May to $950-960/ton cfr in early June.

The east coast MEG import inventories went up to around 950,000 tons. The June ACP was rolled over at $1150-1190/ton cfr and MEGlobal announced a drop of $90/ton to $1100/ton Cfr for its July ACP.

### Asia - Bio-based

Bio-MEG for the global market is produced in India by India Glycols using ethylene from molasses (125 ktpa) and in Taiwan by Greencol, using ethylene made from sugar cane-based ethanol from Brazil (130 ktpa). This material is used, among other things, to make Plant Bottle © for Coca Cola, a product that is marketed as being up to one third plant based (that is, the glycols part of the PET bottle is bio-based; the remainder being PTA, which until now, can not be made commercially from bio intermediates). Bio-MEG from India is sent directly to the USA, Taiwan, the U.K., Mexico and Indonesia. Bio-MEG is shipped from Taiwan to Japan for use in specialty products by Toyota Tsusho (automotive interior polyester fabrics). There are also some exports of Indian bio-MEG to the UK, where some specialty PET is manufactured.

## POLYETHYLENE TEREPHTHALATE (PET)

### North America - Petrochemical

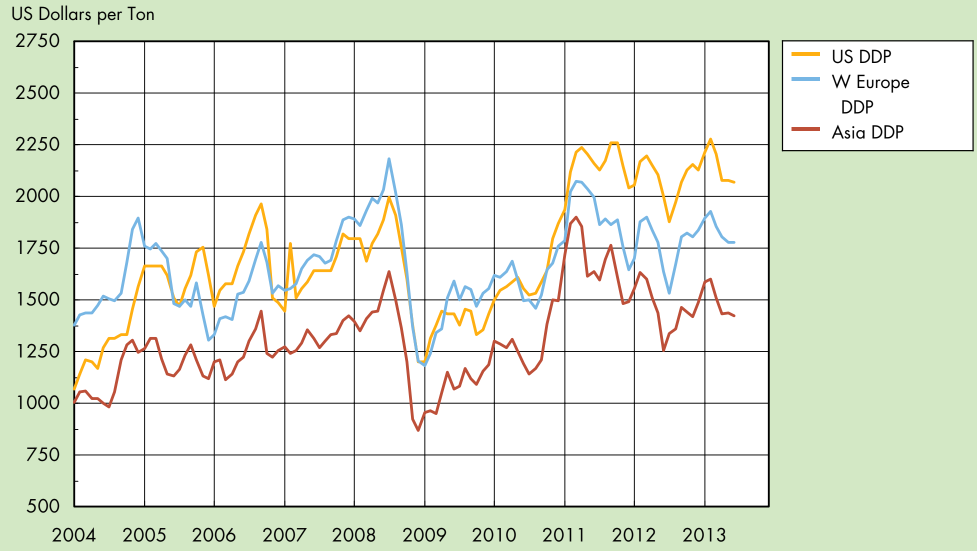
North American PET resin shipments in June were described as good, but modestly below seasonal expectations. Resin prices were generally steady with May as raw material costs have been unusually stable for the third month in a row. Utilisation rates were reported in the mid-80s. Dak Americas has announced a capacity rationalisation plan that includes shutting its Cape Fear facility by September this year. The move follows DAK's announcement to team with M&G and take output from M&G's planned 1,000 ktpa Corpus Christi facility and Indorama's 540 ktpa expansion in Decatur, Alabama.

### The Americas - Bio-based

Competition continues amongst many brand owners to achieve 100% bio-PET but this goal has not yet been reached. Coca Cola is producing its PlantBottle © PET bottle, which is up to one third bio-based (the MEG component of the bottle can be replaced in part or wholly with bio-MEG), since 2009. Partly bio-sourced PET is produced by Dak in the United States and South America with MEG from Asia. Indorama is selling Asian produced bio-PET in the US market. Prices at around $2250/ton are understood to be about $100-150/ton higher than those for conventional PET.

On PET feedstocks, apart from MEG, no commercial products are yet available. There are a lot of projects in the works, however.

**UNITED STATES, WEST EUROPE & ASIA**
**PET RESIN CONTRACT PRICES**




Source: Tecnon OrbiChem

California-based Micromidas Inc. recently announced that it has developed a chemo catalytic route to paraxylene from cellulosic biomass (e.g. post-consumer paper products, agricultural residues, wood waste, paper sludge) and ethylene. Micromidas has determined that the first commodity chemical that it will produce will be paraxylene (PX), and the company reports that recent trials indicate that their process is directly competitive with naphtha-based PX.

Brand owners like Coca Cola and PepsiCo are on the hunt for 100% bio-based PET bottle packaging that will be cost-competitive with petroleum-based PET.

According to Micromidas, the company is currently commissioning a pilot plant with a nameplate capacity of 500 kg/day of PX. The company said its highly selective synthesis produces only biobased PX without the presence of meta or orthoxylene monomers. Their process does not involve fermentation.

According to the company's report, Micromidas's process achieves very high yields, utilizing a 3-step standard chemical conversion with conventional reactor/separation equipment and configurations. The process is highly flexible, capable of handling a wide variety of waste feedstocks such as OCC, rice hulls, empty palm fruit bunches, paper sludge, and wood chips. Further details regarding the process and economics are expected to be released in late June.

Dak Argentina is producing bio-PET for use by converters for Coca Cola, Danone and Nestle.

## West Europe - Petrochemical

West European PET resin demand was mixed during June depending on country and market segment. Resin prices decreased modestly in line with declining raw material costs. Regional and market segment demand differences have led to broadly different utilisation rates between producers. Supply chain destocking has increasingly localised sourcing decisions helping regional producers be more competitive with imports..

## West Europe - Bio-based

Indorama UK is producing some bio-PET for the European market, using bio-MEG from Asia, according to sources. Avantium, a renewable chemicals company, and ALPLA Werke Alwin Lehner GmbH, one of the world's leading plastic converters, announced on 30 May their Joint Development Agreement for the development of polyethylene furanoate (PEF) bottles. After The Coca Cola Company and Danone, ALPLA is the third company to collaborate with Avantium on PEF, a bioplastic based on Avantium's proprietary

**EUROPEAN UNION IMPORTS**
**PET RESIN**

| | March 2013 | | Jan-Mar 13 | Jan-Mar 12 |
|---|---|---|---|---|
| | Tons | $/Ton | Tons | Tons |
| Mexico | 159 | 1,893 | 3,968 | 4,423 |
| Switzerland | 367 | 1,448 | 1,307 | 1,513 |
| Croatia | 578 | 1,025 | 1,595 | 896 |
| Russia | 350 | 1,644 | 998 | 14,377 |
| Egypt | 405 | 1,336 | 1,575 | - |
| Oman | 10,918 | 1,557 | 38,800 | 30,521 |
| Turkey | 275 | 2,169 | 560 | 563 |
| UAE | 451 | 1,561 | 6,362 | 15,774 |
| India | 10,931 | 1,555 | 29,469 | 11,091 |
| Malaysia | - | - | 308 | 1,712 |
| China | 1,010 | 1,683 | 6,240 | 5,649 |
| South Korea | 8,917 | 1,567 | 35,459 | 58,098 |
| Taiwan | 1,876 | 1,742 | 4,560 | 1,782 |
| Non-EU Suppression | 2,597 | 1,640 | 6,371 | 11,654 |
| Not Determin Extra | 225 | 1,554 | 1,462 | 726 |
| Others | 100 | 2,377 | 517 | 1,586 |
| Total | 39,159 | | 139,551 | 160,365 |

The figures in this table are the total, summed over all 27 EU countries, of trade with countries outside the EU. Readers should note, however, that some EU countries may have suppressed data if trade for this product is commercially sensitive, so it is possible that there is under-reporting in the above figures.
$/ton figures are calculated from customs data and may not reflect market prices

YXY technology. The goal of these collaborations is to bring 100% biobased PEF bottles to the market by 2016. This would replace some PET production, which up to this point is only up to one third biobased.

## Asia - Petrochemical

Although June's PET resin exports for Chinese producers were steady with May's strong levels, domestic shipments were modestly lower and below seasonal expectations. Export volumes were good primarily due to compromises in pricing which has damaged margins. Weaker domestic demand has resulted in modestly lower utilisation rates (85-90%) and increasing finished product stocks. Additional capacity due to start in July and August will make it more difficult for producers to recover margin, particularly as the market enters the fall season.

PET resin markets for South Korean and Taiwanese producers were the reverse of China with weakening export shipments, but seasonal strong domestic demand.

## Asia - Bio-based

Far Eastern New Century is producing about 30-40 ktpa of partially bio-based PET in Taiwan, using green MEG from India Glycols, in India. This product is produced on a tolling basis for Coca cola, Danone and Nestle. Nanya is reportedly considering bio-PET but has not yet made this investment decision. In Korea, Lotte is producing bio-PET but sourcing of bio-MEG from Taiwan has been limited and operating rates on bio-PET have been estimated at 50% of capacity or less. Limited demand from Europe, which was expected to be the target market for much of this material, has also resulted in low operating rates.

Teijin is producing bio-based PET marketed under the brand ECO Circle PlantFiber. Teijin said the bio-polyester has been selected for use in the seats and interior trim surface of the 100% electric Nissan LEAF automobile. ECO CIRCLE Plantfiber is used for the seats, parts of the door trim, headrests and centre armrest. The seat and interior trim surface were co-developed by Teijin, automotive seat manufacturer Suminoe Teijin Techno Co., Ltd. and Nissan Motor Company Ltd. Teijin said it has been expanding its ECO Circle Plantfiber's global market for applications ranging from apparel, car seats and interiors to personal hygiene products. The company aims to increase sales to over 50% of its total polyester fibre sales for automotive seats and interiors by 2015. Teijin started its bio-PET fibre production around April 2012.

Teijin produces its own petroleum based DMT with a total capacity of 230 ktpa at the Matsuyama Factory in Ehime Prefecture, Japan. The source of its bio-EG could be Greencol Taiwan, a joint venture between Toyota Tsusho and chemical firm China Man-made Fiber Corp. (CMFC).

Teijin's bioplastic polyester business, while not 100% bio-based, does boast recyclability. ECO CIRCLE Plantfiber can be recycled using Teijin Fibers' ECO CIRCLE closed-loop polyester recycling system. The polyester is chemically decomposed at the molecular level by the system and then recycled as new DMT material comparable to petroleum-derived DMT.

Teijin said in 2011 that it has already produced its own 100% bio-PET fibre in the laboratory but there has been no update to this.

In March 2013, Toyota Tsusho announced that by May this year it will be using bio-based PET from bio-MEG in its newly introduced, GLOBIO for the PET bottles of Suntory Natural Mineral Water, from three natural sources (Okudaisen, Minami Alps, and Aso).

GLOBIO consists of bio-based mono-ethylene glycol made by plant-derived bio ethanol, and refers to all Bio-polyethylene terephthalate (Bio-PET) plastics produced and sold start-to-finish by Toyota Tsusho. The company estimates that since annual global demand for petroleum-based PET plastics is currently estimated at approximately 60 million tons, it is predicted that with the rise of awareness regarding the need for coexistence with nature, adoption of plant-derived PET plastics will expand approximately to more than 5% (approximately 3 million tons) of total demand by 2015.

## POLYAMIDES & INTERMEDIATES

### North America - Petrochemical

Rumours about an extended shutdown at one Texas adipic acid plant continue to swirl around, allowing rival producers to claim that the adipic acid market has become much tighter in May and June. There is some agreement that less adipic acid is being exported from the US to Europe in the second quarter, but this is somewhat short of a confirmation that US production has been reduced.

Demand for adipic acid is steady from most downstream applications, and increasing in others. The automotive sector is growing strongly across North America, and the housing sector continues to show bright spots here and there.

Adipic acid prices based on feedstock cost formulas have shown no consistent up or down trends since the beginning of the year, and spot transactions are too thin to provide any indication for the overall market. Open market prices are 100-105 c/lb.

A scheduled shutdown at the Brazil plant is expected shortly, but the exact timing and duration are details that have not been confirmed.

### North America - Bio-based

US biobased adipic acid developer Rennovia has successfully demonstrated production of hexamethylenediamine (HMDA) from glucose in a pilot phase. HMDA can be produced using adipic acid as feedstock (although this process is outdated and no longer used) but, according to Rennovia, the company has developed a lower-cost route of directly producing HMDA from sugars

HMDA is a precursor for the production of Polyamide 6,6 in combination with adipic acid. The intermediate is currently produced from petroleum-derived propylene or butadiene. The market for HMDA is estimated at 1361 ktpa with a value or more than $4 billion worldwide.

Rennovia expects production costs for its bio-based HMDA to be 20-25% below that of conventional petroleum-based HMDA with significantly lower per-unit capital cost. Rennovia's next step is to produce bio-based HMDA and glucose-based adipic acid at a demonstration scale. Rennovia has already refined its bio-adipic acid process after more than 18 months of pilot operation.

The company is targeting a commercial demonstration unit for bio-adipic acid by 2014 with a fully integrated mini-plant designed to allow direct scale-up to the full commercial scale of 135 ktpa, which is anticipated for 2018.

Rennovia claims that its bio-based adipic acid will be highly cost-competitive not only against petroleum-based adipic acid but bio-based materials that are currently being developed by companies such as Verdezyne, BioAmber, DSM and Genomatica.

The current adipic acid price of around $2205/ton ddp is based on cyclohexane prices of around $1335/ton fob. Bio-based feedstock is much lower in price at around $300/ton for glucose, suggesting there may be an advantage for bio-based adipic acid, depending on where production and other costs come in.

Verdezyne announced in June that it has partnered with Malaysian Biotechnology Corporation (BiotechCorp) in order to assess Malaysia for its first biochemical production facility in the Asia Pacific region. Verdezyne is currently producing 5-15 kg per week of bio-based adipic acid and other diacids from its pilot plant in California using plant-based oils and their by-products such as palm fatty acids and distillates.

## West Europe - Petrochemical

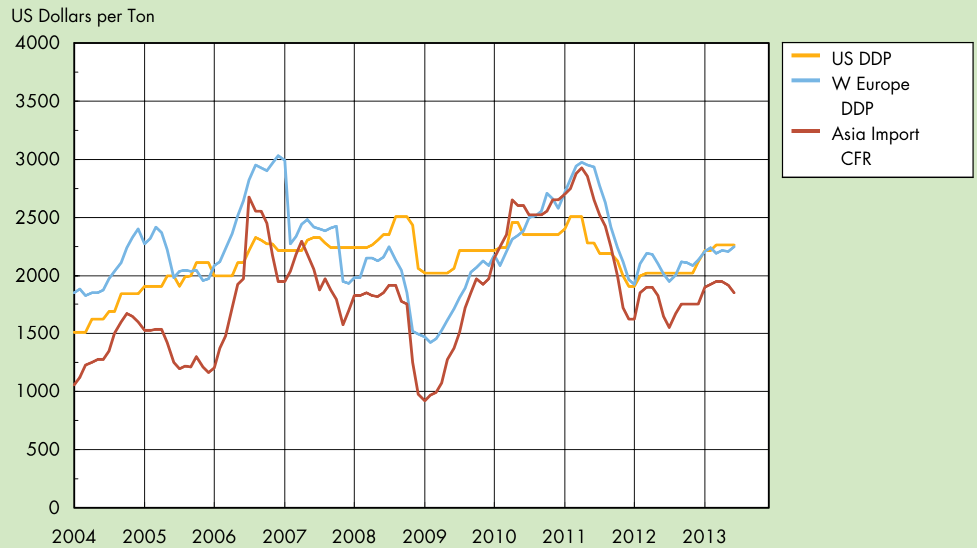
BASF has decided to extend its partial adipic acid shutdown at Ludwigshafen, Germany. The company initially planned a three-month shutdown of 25% of its adipic acid capacity, but this has now been extended indefinitely.

Solvay has shut down one of its three polyamide 66 polymer lines at St Fons, France, where total capacity is estimated at around 100 ktpa. The closure is described as temporary, but it is not hard to imagine a permanent shutdown in the current market.

BASF and Solvay are both confronted by declining profitability in the polyamide business in Europe. One has reduced its production of adipic acid and the other has reduced its consumption, but since both are partially integrated, the overall effect on the adipic acid market is unclear. Indeed, the closures introduce a new level of complexity to an adipic acid market that was already somewhat complicated.

A new carbon-credit regime took effect at the beginning of the year, so some of the deep-discounting we saw at the end of 2012 is no longer a feature of the market. The very lowest prices for adipic acid have disappeared, but sellers have struggled to implement higher prices with their best customers.

**UNITED STATES, WEST EUROPE & ASIA
ADIPIC ACID CONTRACT PRICES**




Source: Tecnon OrbiChem

Spot material is still offered at around €1500/ton ddp West Europe.

May prices have been confirmed with increases of €10-20/ton for some customers, based on feedstocks. There is no consensus view on the direction of June pricing, but the lower benzene price and weakness in many downstream markets suggest that June prices could be lower.

### West Europe - Bio-based

In Europe, PA 6,10 is becoming a popular bio-based polyamide. The 60% by weight bio-based component of PA 6,10 is made from sebacic acid, a 10-carbon dicarboxylic acid derived from castor oil's major fatty acid component ricinoleic acid.

Producers of PA 6,10 include Arkema, Evonik, BASF, EMS-Chemie, DuPont and Solvay.

Belgium-based chemical firm, Solvay, through its polyamide and intermediates business, plans to invest in a bio-based PA 6,10 production unit at its Saint-Fons Belle-Etoile site in Lyon. Solvay has not disclosed capacity figures for the new production unit.

Solvay is currently marketing its PA 6,10 products under the brand Technyl® eXten, which was first introduced in 2009. PA 6,10 is functionally similar to PA 6 and PA 6,6 resins but has heightened high-temperature and chemical resistance as well as rigidity that put it into the category of a high-performance plastic.

PA 6,10 can be used in automotive applications such as in flexible fluid-transfer tubes, high-end fittings and adapters for engine fuel systems.

### Asia - Petrochemical

The Japanese domestic adipic acid demand continues to be weak from May to early June. Adipic acid demand for PA 6,6 engineering plastics and airbag yarn is stronger as car production in Japan has been improving. However, demand for other applications such as polyurethane and adipate plasticizers is not yet recovering. There are yet no signs for recovery within next two to three months.

Looking at the Asian adipic acid export market, demand is still very weak across various countries. Despite the weak demand, the supply capability of adipic acid has increased in recent years mainly due to enormous expansions in China. This led to head-to-head competition even outside the Chinese market, for instance in the Taiwanese and Korean markets, leading to lower export prices. According to Japanese sources, some Chinese adipic acid producers are now offering prices even below $1600/ton fob China main port. As such prices are too low even for Chinese adipic acid producers, they are considered to be rock-bottom prices and no further serious price erosion appears to be likely unless there are significant changes in basic feedstock prices. However, there is as yet no sign for the price correction in the next two to three months as the demand is expected to be very slow in the meantime.

In the past, the major supplying countries in Asia (outside China mainland) were South Korea, Singapore and to a lesser extent Japan as local suppliers. In addition, the US and EU are major supplying countries depending on destinations. Such a basic supply structure started to change significantly from 2011/2012 and the change is going to accelerate in 2013. Singapore has almost disappeared from the merchant market in 2013. The shift to Chinese products is a clear trend despite still existing quality differences.

As regards adipic acid imports into Japan, the most serious problem for the importers at the moment is the very rapid depreciation of Yen, which means tremendous increases in the import cost. Importers are seriously concerned over increasing the domestic selling prices.

Chinese adipic acid demand remained weak in May and the first half of June. Entering June, the demand for polyurethane resin decreased further, as summer is the traditional off-season. This coupled with the economic recession left the polyurethane resin market in June weaker than May. Synthetic leather resin and shoe sole resin prices decreased Rmb300/ton and Rmb1000/ton in early June. In the first half of June, polyurethane resin producers further decreased their operating rates from May due to the softened market. Synthetic leather resin producers were running on average at 40%, while the shoe sole resin producers

**CHINESE EXPORTS**
**ADIPIC ACID**

| | April 2013 | | Jan-Apr 13 | Jan-Apr 12 |
|---|---|---|---|---|
| | Tons | $/Ton | Tons | Tons |
| Italy | 418 | 1,654 | 1,087 | 578 |
| Turkey | 329 | 1,611 | 329 | - |
| India | 711 | 1,856 | 1,528 | 819 |
| Indonesia | 191 | 1,862 | 478 | 303 |
| Singapore | 3,780 | 1,824 | 10,216 | 867 |
| Thailand | 1,314 | 1,679 | 2,774 | 542 |
| Vietnam | 158 | 1,931 | 264 | 350 |
| South Korea | 989 | 1,766 | 6,215 | 3,795 |
| Taiwan | 2,446 | 1,741 | 6,593 | 1,443 |
| Japan | 438 | 1,943 | 1,715 | 1,174 |
| Others | 397 | 1,951 | 2,088 | 2,882 |
| Total | 11,171 | | 33,287 | 12,753 |

**CHINESE IMPORTS**
**ADIPIC ACID**

| | April 2013 | | Jan-Apr 13 | Jan-Apr 12 |
|---|---|---|---|---|
| | Tons | $/Ton | Tons | Tons |
| Germany | 431 | 1,849 | 1,559 | 1,569 |
| Ukraine | - | - | - | 4,355 |
| Singapore | - | - | - | 1,458 |
| South Korea | 1,654 | 2,035 | 6,014 | 7,427 |
| Japan | 155 | 2,537 | 558 | 1,471 |
| Others | 28 | 3,608 | 144 | 209 |
| Total | 2,268 | | 8,275 | 16,489 |

$/ton figures are calculated from customs data and may not reflect market prices

decreased operating rates to 40-50% on average. The polyamide 66 polymer market, the other major application for adipic acid, remained weak in May and early June.

Spot adipic acid prices saw a further decrease of Rmb200-400/ton from early May to early June, down to Rmb10800-12300/ton on a cash basis in early June, the high side price is Liaoyang Petrochemical cargoes, with a Rmb200/ton drop in the past month. The low side price is for other domestic cargoes, which decreased more than high-quality cargoes. Some Shandong producers even quoted at Rmb10600-10700/ton.

The May contract for adipic acid settled down in a range of Rmb11200-12600/ton delivered, L/C basis, with the high-end price unchanged and a decrease of Rmb450/ton in the low-end price, compared to the settling prices of April. The listing prices in June from Liaoyang Petrochemical and Xinjiang Dushanzi Tianli, which both belong to China National Petroleum Corporation, decreased Rmb300/ton compared to their settling price in May. The other producers' listing prices in June remained the same as their settling prices in May. June contract prices are listed in a range of Rmb11200-12300/ton provisionally, with Liaoyang Petrochemical at Rmb12300/ton and the others at Rmb11200-11500/ton.

Most adipic acid producers are running at a loss. Though the benzene prices decreased Rmb400-450/ton in May and remained stable at Rmb8900-9050/ton in early June, the adipic acid prices decreased accordingly. The loss of margin forced adipic acid producers to operate at a reduced rate at around 49% on average in the first half of June. Some producers shut down operations in June or have maintenance plan in July, but it this will not support the market as the market supply is sufficient for the weak demand. Domestic prices are expected to further drop by Rmb100-200/ton in the second half of June.

As far as production goes, Liaoyang Petrochemical was running one 70 ktpa line normally in June, and this line will shut down in July for around 2-3 month's maintenance; the other 70 ktpa line was still closed, currently this plant mainly supplies export orders. Shandong Hongye restarted one 70 ktpa unit on 3 June and the other 70 ktpa line remained shut; Shandong Hualu Hengsheng was running one 80 ktpa line at 220 tons per day. The two adipic acid lines (150 ktpa capacity each) in Shandong Haili's Jiangsu plant were both shut down for maintenance on 1 June and the turnaround will last for around 15-20days. Shandong Haili's Shandong plant has been running one 75 ktpa line. Dushanzi Tianli's 75 ktpa line is running at 70-80%. Zhejiang Shuyang Chemical is planning to start up the new 80 ktpa adipic acid unit in July.

In the second week of June, the export price was quoted at $1620-1790/ton FOB China while the import price was quoted at $1800-1900/ton CIF China. With the domestic prices going down, the import prices were also forced to fall by $50-80/ton compared to mid-May.

In April, China exported 11,172 tons adipic acid, 16.54% up from March, and the total export volume from January to April was 33,287 tons, 161% up from the same period in 2012. The import in April was 2,268 tons, 17% increase from March, and the total import volume from January to April was 8,275 tons, 49.82% drop year on year. China has become a net exporter since 2012.

**Asia - Bio-based**

Specialty chemicals firm, Arkema, has acquired a 25% stake in castor oil producer, Ihsedu Agrochem, a subsidiary of major Indian castor oil and derivatives producer, Jayant Agrochem.

According to Arkema, the joint venture with Jayant Agro is in line with its strategy to secure supply of a key raw material in order to support the development of its bio-polyamides in fast-growing applications such as materials for lighter vehicles and in oil and gas extraction.

Arkema is the only producer of PA11 that uses the castor oil-based monomer 11-aminoundecanoic acid as feedstock. Arkema's PA11 is marketed under the tradename Rilsan® 11. The company also produces PA10 made with sebacic acid under the brand Hiprolon®.

Sebacic acid prices are highly dependent on castor oil prices. Castor oil prices within the past few months were pegged at around $1500/metric ton, the lowest in four years and down from a February 2011 peak of $2750 per metric ton.

Export values of sebacic acid and derivatives from China between January and March 2013 were estimated at a range of $3500/ton to $5000/ton. Prices for PA 6,6 engineering resins in China are at around $2800/ton cfr China, currently. Prices for PA 10,10 are said to be at least twice the price of PA 6,6 but details are not available at this point. (There is no bio-based PA 6,6 yet)

**China: Export Of Azelaic And Sebacic Acid In Key Markets April 2013 (Metric Tons)**

| *Country* | *April 2013* | *Jan-Apr 2012* | *Jan-Apr 2013* |
|---|---|---|---|
| Netherlands | 617 | 2658 | 2865 |
| U.S. | 712 | 2442 | 2423 |
| Japan | 617 | 1786 | 1836 |
| Italy | 320 | 2251 | 1186 |
| Germany | 308 | 467 | 1039 |
| France | 244 | 784 | 785 |
| Belgium | 182 | 631 | 460 |
| South Korea | 115 | 443 | 494 |
| **World Total** | **3527** | **13361** | **12725** |

Source: China Customs

# PROPYLENE GLYCOL

## North America - Petrochemical

Demand in the monopropylene glycol sector in North America has remained largely flat this month. Industrial grade MPG is on the long side due to the sluggish performance of some end use markets. The UPR market for example was steady in May with a small uptick in demand but no significant improvement. The pipe market is still the strongest downstream sector for UPR but construction should be picking up further this month.

USP grade MPG demand remains steady, with its main applications being fragrances, flavours and pharmaceuticals which are less subject to fluctuation.

One MPG producer has recently announced a price increase of 3c/lb effective 1 July for off-list customers in North and South America. This is based on price increases in feedstock markets.

Buyers have noted a decline in price over the past two months, based on the drop in feedstock prices, and there are some who expect to see a potential further decline of perhaps up to 5 cents in the coming month. Clearly producers are keen to counteract any further slippage in price. It is possible that the two opposing views could result in a rollover price for July.

Propylene fell by 5c/lb in May contract negotiations. Subsequently, there have been nominations of an increase of 2-3c/lb for June, and initial indications show that propylene contracts have settled up by 2c/lb.

The price monitor for May has been adjusted to reflect the outcome of price discussions which has been confirmed at a decrease of 4-6c/lb. June has also seen a further decrease in monthly pricing of a similar amount, resulting in price for June of 74-87c/lb.

## North America - Bio-based

The US refined glycerine price has steadily increased since December 2011, driven by healthy demand and tightening supply. The glycerine contract price is currently quoted at around $1000/ton fob, compared to around $900/ton seen in mid-2011.

Soft demand from the de-icing sector combined with high refined glycerine prices and competitive petroleum-based mono propylene glycol (MPG) prices have narrowed margins for bio-based MPG.

Archer Daniels Midland (ADM) is the only producer of bio-based MPG in the US with a capacity of 100 ktpa located in Decatur, Illinois. ADM produces both industrial grade and USP grade using refined glycerine as a feedstock, although the company has said it can also use corn-based sorbitol as raw material.

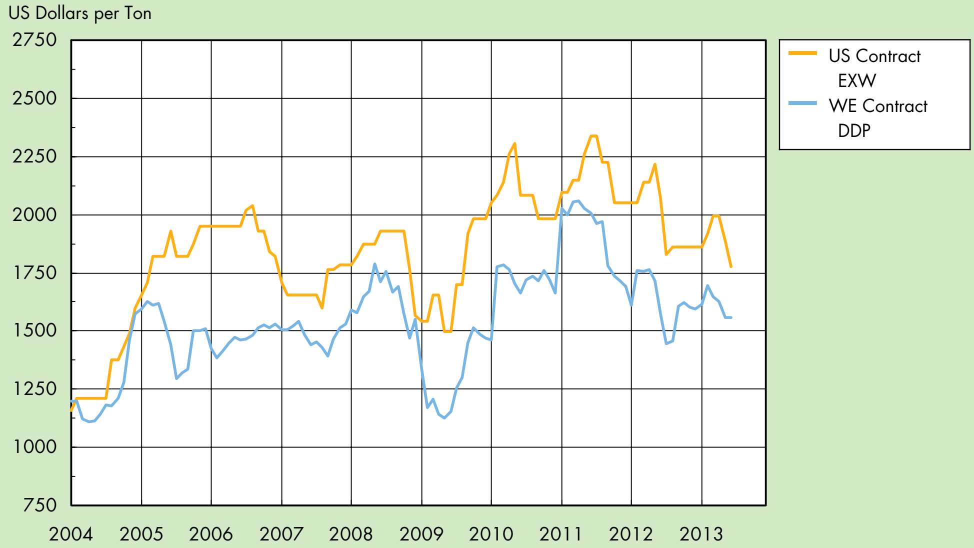
DuPont Tate & Lyle Bioproducts is currently offering its bio-based 1,3 propanediol (PDO), Susterra®, as an alternative to MPG in heat transfer fluid applications. BioAmber is also offering heat transfer fluids and coolants that use its bio-based succinic acid material under the trademark Bio-SA™.

## West Europe - Petrochemical

The European MPG market has stabilised this month, with the small increase in feedstock propylene going some way to halting the downtrend in MPG pricing. The average price range for MPG industrial grade this month is pegged within a fairly narrow range at €1170-1200/ton. There are some prices reported below the €1170/ton level and also some pricing at about €1210-1220/ton, although these are not considered representative of the majority of current business.

As far as demand goes, the main downstream sector, UPR is at its seasonal peak, with offtake in the construction sector showing some improvement. Although the building season was slower to start this year as a result of the extended winter weather, May and June have seen a reasonable pick up. However, this market is still not performing strongly in Europe, although growth is seen in Turkey and the Middle East.

**UNITED STATES & WEST EUROPE PROPYLENE GLYCOL PRICES**




Source: Tecnon OrbiChem

Demand for USP grade is steady, with key downstream markets food and pharmaceuticals remaining consistent, and some improvements seen in use of liquid detergents.

The MPG market is well supplied. Dow took a maintenance shutdown for approximately two weeks, with the plant having reopened by Monday 10 June. Stocks had been built prior to the planned shutdown and this has therefore minimised the effect on overall product availability.

It is likely that prices will remain fairly steady in July, although this depends to some extent on the movement of propylene pricing.

## West Europe - Bio-based

Contract glycerine prices in Northwest Europe rose to between €700/ton and €800/ton in late 2012 to early 2013, compared to the price range of €450-€650/ton seen in 2011. Current second quarter glycerine contract prices, however, have fallen to €570-€650/ton.

A high price for refined glycerine in Europe has led to reports of Oleon suspending its bio-based MPG production at its 20 ktpa facility in Ertvelde, Belgium, between November 2012 and the first quarter of 2013. Selling the feedstock glycerine was more attractive to Oleon than taking the extra step to convert it to MPG.

Oleon started producing bio-based MPG last year in July after converting a former fatty alcohol plant at the Ertvelde site. The bio-based MPG process has been developed and licensed by BASF in collaboration with Oleon. BASF also supplies the catalysts for the plant.

## Asia - Bio-based

Hong Kong-based Global Bio-chem Technology Group Co. Ltd. reported in its annual earnings review that the average selling price for its bio-based MPG for 2012 declined by 13% year-on-year.

Global Bio-chem reported that 54% of its bio-based polyol prices are usually accounted for by raw material costs. The average corn cost in China for most of 2012 and early 2013 is up 7% year-on-year, according to Global Bio-chem. The corn price in northeast China for the first quarter of 2013 was estimated at Rmb2,370/ton ($386/ton), including VAT.

The company believes corn prices will start to come down with better global corn supply this year. Sorbitol is commercially produced by the hydrogenation of glucose from the starch fraction of the corn kernel. The sorbitol price in Asia Pacific this year is quoted around $640-$650/ton.

The company resumed production of its sorbitol-based MPG in October 2012 after relocating its 200 ktpa glycol plant from Changchun to Xinglongshan, China. Global Bio-chem halted production of bio-based MPG in Changchun in September 2011.

The current utilization rate for bio-based MPG in Xinglongshan, however, is placed at 60% as high corn prices and low oil prices made bio-based MPG less competitive.

Global Bio-chem said it plans to expand its bio-based polyol chemical production in Xinglongshan by an additional 500 ktpa capacity, depending on market performance for its bio-based MPG. The company has also formed a collaboration with ADM on the development of a catalyst for improving production of glycerine from carbohydrates in order to bring significant cost-savings and efficiencies to their production of bio-based PG and ethylene glycol.

## BUTANOLS

### North America - Petrochemical

Demand in the US n-butanol market remains healthy. Some supplier sources are reporting an increasing number of enquiries, partly due to the knock-on effect of tightening supply in other regions, with several plants going through or preparing for turnarounds in West Europe. The market is understood to be balanced-to-tight. In June, n-butanol prices have rolled over and n-butanol accounts consuming a few million pounds annually are heard to be paying about 106-107 c/lb, with those taking less than 1 mmlbs/year at around 112 c/lb or slightly below.

### North America - Bio-based

Gevo started producing bio-iso butanol again in June but operating rates and volume produced will depend on corn prices, oil prices and iso butanol prices this year. The company produced roughly 150,000 gallons of crude bio-iso butanol last year to carry over contractual commitments to its customers for this year until it starts up the Luverne plant again.

Gevo's 18m gal/year (55 ktpa) bio-iso butanol production in Luverne, Minnesota, has been shut down since the fourth quarter of 2012, as the company reported sterilization issues as well as the need to maximize cash flow. The facility has the flexibility of producing quantities of corn-based iso butanol and ethanol depending on the demand. Gevo stopped producing bio ethanol last year stating the reason as high US corn prices as a result of the drought.

Mid-west corn prices in September 2012 were at a record high of $7.70/bushel, according to the USDA. Prices this year are gradually coming down from $7.17/bushel in January to $6.83/bushel in May 2013.

Gevo said its goal this year is to produce consistent quantities and quality of bio-iso butanol at economically viable rates. The petroleum-based contract iso butanol price in May was around $2,900/ton, US Gulf.

Early this year, Gevo signed a supply deal with the US Army to sell up to 15,000 gallons of renewable jet fuel from bio-iso butanol and late last year, the Department of Defense ordered 45,000 gallons of the same jet fuel. Gevo has already been contracted to deliver 3,650 gallons of renewable jet fuel in the second quarter of 2013 to the US Army at a fixed price of $59/gal.

Gevo is currently the sole commercial producer of bio-iso butanol worldwide. Butamax Advanced Biofuels, the joint venture between DuPont and BP, is producing bio-iso butanol at its 30 ktpa demonstration plant in Hull, UK, mostly for customer testing in biofuel applications. Butamax's business model is to offer retrofitting of current ethanol facilities with its proprietary bio butanol technology to improve plant profitability.

Butamax expects its first retrofitted ethanol plant in the US to start commercial production of bio-iso butanol in 2014 with a nameplate capacity of 50 million gal/year.

## West Europe - Petrochemical

In West Europe, availability in the n-butanol market is heard to be snug with some sources reporting supply has been tightening in June as a number of plants are going through or preparing for shutdowns during this month. On the other hand, demand has seen some seasonal improvement in the past month, although other sources are still reporting lower-than expected volumes. Looking at pricing, as propylene prices have moved up by €15/ton to settle at €1040/ton in June, formula prices linked with propylene have risen by around €10/ton. For spot tanktruck prices, supplier sources are reporting more competition and prices have been assessed in the range of €1110-1160/ton.

## West Europe - Bio-based

Spain-based Abengoa Bioenergy announced early this year that it is planning to enter the bio-based n-butanol market with a catalytic conversion technology that it has been developing. The Abengoa technology involves catalytic condensation of ethanol to produce butanol through the Guerbet reaction. The company said its patented catalyst allows cost-competitive manufacture of bio butanol from ethanol.

The petroleum-based n-butanol contract price in Europe for May was estimated at €1100/ton. The spot range is reported at €1100-1150/ton.

Abengoa currently has several corn-based ethanol facilities running in the US and Europe. The company said it plans to retrofit two of its ethanol plants to produce bio-based n-butanol without having to halt the ethanol production process. Abengoa did not disclose specific ethanol plants being targeted for conversion.

Other companies working on the development of bio-based n-butanol in Europe include UK-based Green Biologics, France-based METabolic EXplorer, Germany-based Butalco, and Celtic Renewables based in Scotland.

Green Biologics has partnered with China-based Laihe Rockley for demonstration production of bio-based n-butanol that uses cellulosic feedstock at Laihe Rockley's 150 ktpa facility in Jilin. Late last year, Green Biologics said it was able to produce and export 55 tons of bio-based n-butanol from Jilin mostly for testing purposes.

METabolic EXplorer announced in March that it has suspended its development of bio-based n-butanol because of discontinued funding from a European-based program called Bio2Chem.

## China - Petrochemical

In China, dragged down by sluggish downstream demand and fierce price competition amongst domestic producers, n-butanol ex-work prices have slumped by Rmb1000/ton to the range of Rmb8600-8900/ton (netback to cif import prices at $1131-1170/ton) some producers are willing to be more flexible to finalise deals . Spot prices in eastern China have also tumbled 8% compared to last month and have been assessed in the range of Rmb9200-9300/ton (netback to cif import prices at $1210-1223/ton).

## China - Bio-based

It was reported late last year that the operating rate for the 100 ktpa Cathay Industrial Biotech bio-based n-butanol facility in Jilin Province, China, is very low and even that the company has suspended production due to high corn prices. An update has not yet been available this month.

According to Green Biologics, China's existing bio-based n-butanol capacity exceeds 300 ktpa spread over six major sites and a number of smaller facilities across China. Unfortunately, most of the facilities are either idled or operating at low rates because of high feedstock prices.

**CHINESE IMPORTS**
**N-BUTANOL**

| | *April 2013* | | *Jan-Apr 13* | *Jan-Apr 12* |
|---|---|---|---|---|
| | *Tons* | *$/Ton* | *Tons* | *Tons* |
| United States | 2,674 | 1,498 | 12,660 | 49,756 |
| France | - | - | 1,014 | 1,550 |
| Germany | 81 | 1,570 | 18,622 | 10,151 |
| Russia | 11,874 | 1,437 | 34,501 | 31,814 |
| South Africa | 1,191 | 1,295 | 8,277 | 16,355 |
| Malaysia | 4,160 | 1,555 | 14,613 | 26,146 |
| Singapore | 2,001 | 1,535 | 11,002 | 7,996 |
| Taiwan | 19,721 | 1,508 | 46,483 | 49,158 |
| Japan | 945 | 1,518 | 9,645 | 3,744 |
| Others | - | - | 1,350 | 801 |
| Total | 42,647 | | 158,167 | 197,471 |

$/ton figures are calculated from customs data and may not reflect market prices

**CHINESE IMPORTS**
**N-BUTANOL**
**(1,000 Metric Tons)**

| *Month* | *2011* | *2012* | *2013* | *2012 $/ton* | *2013 $/ton* |
|---|---|---|---|---|---|
| Jan | 52.9 | 56.2 | 38.9 | 1,252 | 1,424 |
| Feb | 43.4 | 52.5 | 36.4 | 1,283 | 1,456 |
| Mar | 51.4 | 39.9 | 40.2 | 1,301 | 1,501 |
| Apr | 35.4 | 48.9 | 42.6 | 1,389 | 1,488 |
| May | 39.1 | 37.6 | - | 1,394 | - |
| Jun | 30.2 | 24.7 | - | 1,401 | - |
| Jul | 43.3 | 23.9 | - | 1,284 | - |
| Aug | 30.6 | 34.1 | - | 1,267 | - |
| Sep | 34.7 | 52.2 | - | 1,326 | - |
| Oct | 31.2 | 40.8 | - | 1,365 | - |
| Nov | 48.0 | 38.8 | - | 1,397 | - |
| Dec | 51.1 | 39.1 | - | 1,430 | - |
| Jan-Apr | 183.1 | 197.5 | 158.2 | 1,304 | 1,468 |
| % Change | (12.9) | 7.9 | (19.9) | (21.5) | 12.6 |
| Jan-Dec | 491.2 | 488.8 | | | |
| % Change | (21.2) | (0.5) | | | |

$/ton figures are calculated from customs data and may not reflect market prices

In September 2012, corn prices in China reached a high of $10/bushel. The corn price in northeast China for the first quarter of 2013 was estimated at Rmb2,370/ton ($386/ton), including VAT. [For corn (maize), 1 bushel = 56 lbs or 25.4 kg]

Domestic prices for petroleum-based n-butanol in China have been softening due to weak demand this year and are estimated in the range of Rmb10000-10100/ton ddp eastern China for the month of May.

Green Biologics currently has three different production contracts in China but its partner Laihe Rockley was the only one that was able to produce bio-based n-butanol using corn waste for Green Biologics.

Laihe Rockley's first batch of waste-based n-butanol amounting to 55 tons was exported to the USA on 26 September 2012. The production was more for testing purposes rather than selling volume, according to Green Biologics. The biomass-based acetone-butanol-ethanol (ABE) production process has a capacity of 40 ktpa and started operations on 5 June 2012.

Green Biologics is hoping to see additional volume of its waste-based n-butanol from the Jilin plant this year but, given high corn feedstock and logistics costs, the company is also looking into producing cellulosic n-butanol in the US or Brazil. Cathay Industrial Biotech is currently developing the use of corn waste for feedstock but production is still at the pilot stage.

# EPICHLOROHYDRIN

## North America - Petrochemical

Prices in the US were more or less stable, although some did come down slightly, by 0.5-1.0 c/lb due to the drop of 1.0 c/lb in the propylene contract price. However, demand appears to be faltering somewhat and there is increased competition on epoxy resins from imported product, predominantly from South Korea. Thus, since the epoxy resin prices dropped this month by some 2-4 c/lb and an oversupply exists from domestic output and imports, then pressure is on ECH prices to fall next month, irrespective of what propylene will do.

## West Europe - Petrochemical

Supplies remained very tight as inventories were extremely low after all the plant turnarounds in April/May. Demand for epoxy resins picked up into the month, but then softened slightly and it seems the import competition is hotting up with increased offers from Asia. The propylene contract price decrease of €80/ton meant that the C3-related contract level came down by €55/ton.

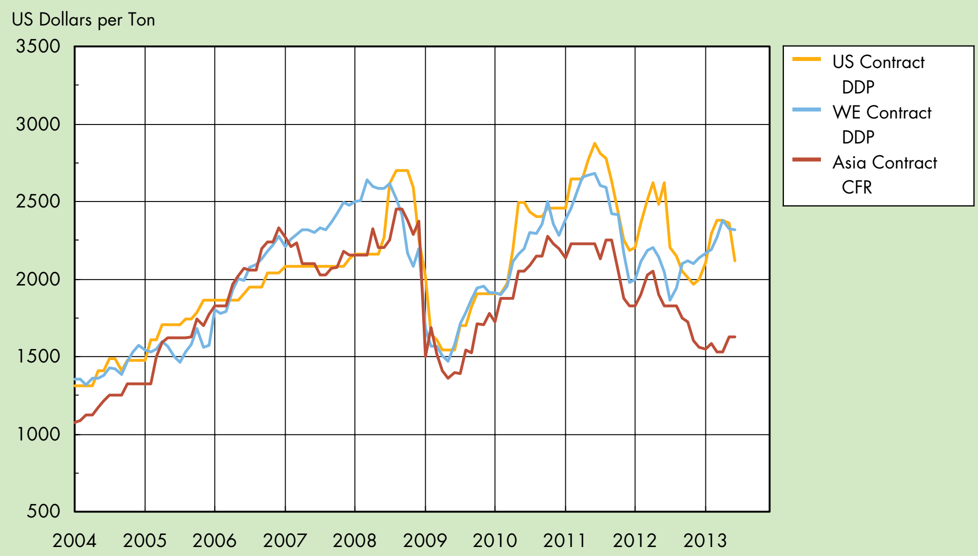
## West Europe - Bio-based

Dutch specialty chemical firm, AkzoNobel, recently signed a deal with Belgium-based chemical group Solvay for the supply of refined glycerine-based ECH between 2013 and 2016. Under the deal, AkzoNobel will guarantee to buy volumes of glycerine-based ECH indirectly via the epoxy resins it purchases from Solvay's customers. Solvay's glycerine-to-ECH process technology is marketed under the trademark Epicerol®.

AkzoNobel said it will progressively increase the use of Epicerol®-based ECH, which is already contained in many of the company's resins for its coatings products. By 2016, AkzoNobel aimed to source 20% of its total ECH demand as bio-based material.

Solvay currently has a 20 ktpa Epicerol®-based production at Tavaux, France, and a 100 ktpa operation in Map Ta Phut, Thailand, operated by its affiliate Vinythai. The Tavaux facility consumes 22 ktpa of refined glycerine sourced from Europe, and the Map Ta Phut facility consumes 110 ktpa of refined glycerine, contracted in Asia.

**UNITED STATES, WEST EUROPE & ASIA EPICHLOROHYDRIN PRICES**




Source: Tecnon OrbiChem

### Asia - Petrochemical

Prices in China went up during the month, mainly because of the increased propylene price. The transaction price in eastern China is in the range from Rmb9800/ton to Rmb 9900/ton EXW. Jiangsu Haili is going to shut down for maintenance at the end of June, thus it raised prices higher, quoting Rmb10700-11000/ton EXW to contract customers. However, demand has weakened further this month. Producers are still facing the situation of losing money and thus operating rates have been cut back to 40-50%. The spot import prices went up by some $100/ton to $1550-1600/ton CFR, but consumers are pushing for $1500/ton and below. Samsung brought back its plant in South Korea at the end of April and is running it now at 60% rate.

### China - Bio-based

Glycerol-based ECH market is considered matured in China. There are currently around six Chinese companies producing ECH via glycerol technology operating at stable rates with comparatively big capacity ranging between 10 ktpa and 100 ktpa. There are also smaller Chinese producers but their operating status are not stable.

Solvay is currently constructing its 100 ktpa Epicerol® plant in Taixing, China, that will be operated by Vinythai. The plant is expected to be operational in the second half of 2014. There were other planned capacity announcements in Asia within the past 2-3 years but industry sources reported that these plans have been postponed either because of petroleum-based ECH overcapacity in the region or increasing high costs of refined glycerine feedstock.

An industry source also indicated that glycerol-based ECH price is currently comparable with petroleum-based ECH price.

## 1,4-BUTANEDIOL

### North America - Petrochemical

1,4-Butanediol market fundamentals in North America remain consistent from May to June. The PBT sector continues to benefit from the recovery of the automotive sector in the US, with BDO volume into this sector above that of last year. May proved to be a strong month for automotive sales in North America, according to figures from Autodata. Car and truck sales rose by 8% in May, which was above forecast.

Other key downstream sectors such as PTMEG, thermoplastic polyurethanes and cast elastomers are steady this month, with performance overall this quarter having remained stable.

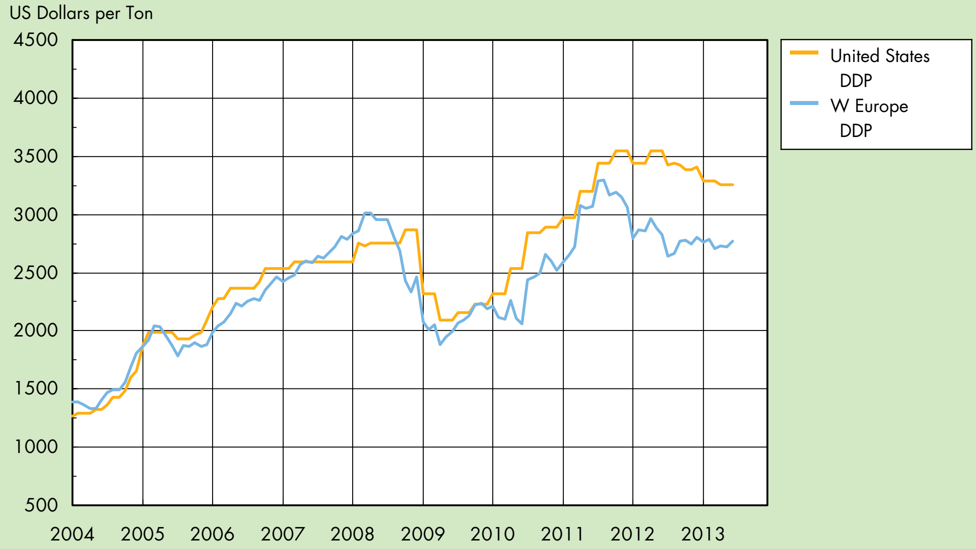
Thoughts are turning towards the third quarter contract, although discussions have yet to get underway. Buyers say they are looking to achieve a decrease for BDO contract prices in quarter three from the price in the second quarter of 141-154c/lb. The reason behind this, they say, is the fact that there is a wide gap between US and Asian prices, and this situation is likely to result in US derivative producers becoming less competitive in a global arena. The upcoming increase in BDO capacity in Asia along with the stagnant market demand in China has left the Asian market weakened and the second half of the year is expected to present some challenges.

US producers have yet to voice any price ideas for the quarter. However, it is likely that they will look to prevent margin erosion by keeping any price decreases to a minimum. The domestic market supply situation is balanced, as it has been through the first half of the year.

### North America - Bio-based

BASF announced last month plans to produce 1,4-butanediol based on renewable feedstock using Genomatica's patented process which uses sugars as a renewable feedstock. The agreement allows BASF to build a world-scale plant using Genomatica's process technology. BASF will have renewable BDO available in the second half of this year for sampling and product trials.

**UNITED STATES & WEST EUROPE**
**1,4-BUTANEDIOL CONTRACT PRICES**




Source: Tecnon OrbiChem

As far as bio-based economics are concerned, Genomatica claims that its bio-BDO is competitive with current petroleum-based BDO prices of around 141c/lb.

Genomatica and DuPont Tate & Lyle Bio Products started commercial production of bio-1,4 BDO in late 2012 at DT&L's Loudon, Tennessee, facility. In a span of five weeks, the companies produced over 2,000 metric tons of BDO by direct fermentation using dextrose sugar supplied by DT&L. This is an equivalent run-rate of over 23 ktpa.

The US dextrose price in Midwest markets was stable at around 35c/lb, dry weight, between December 2012 and May 2013. This is the Wholesale list price for dextrose sugar according to the US Department of Agriculture (USDA) Economic Research Service (ERS). Sugar is a significant component of variable cost in a bio-based BDO process.

Genomatica is the first company to commercially produce bio-based 1,4 BDO. The company reports that the products from the Loudon facility have been delivered for customer testing.

BioAmber, a US-based bio-based succinic acid producer, plans to start up a bio-based 1,4 BDO toll manufacturing plant in the US in late 2014 for consumer sampling, which would have a capacity to produce 2-4 ktpa. The company is identifying several companies that have the infrastructure, know-how and purification equipment needed to convert their bio-succinic acid to bio-based BDO on a toll manufacturing basis.

BioAmber plans to design and install a proprietary hydrogenation reactor at the selected toll manufacturer, to provide a catalyst produced by its partner Evonik, and to supply the toll manufacturer with bio-succinic acid, produced initially at its Lestrem, France, demonstration facility, and subsequently in Sarnia, Ontario, where a 30 ktpa bio-succinic acid facility is being built and which is expected to start operations in 2014.

### West Europe - Petrochemical

BDO market players are beginning to speculate on the direction of contract prices in the third quarter. Although price discussions have not yet begun in earnest, there is a strong expectation amongst some players that the European price will move down in the third quarter, partially as a result of the increase of capacity coming on stream in Asia, but also due to the wide gap between price level in Asia and in Europe. Some expect that the main threat to market stability in Europe may come from the importing of BDO derivatives from Asia into Europe rather than the importing of the raw material BDO into Europe.

Producers are expected to opt for a rollover position in an attempt to minimise any loss of margin. However, at this point, no announcements have been heard. Buyers are clearly expecting to see a downward shift in price for the third quarter and are likely to push hard with the argument of needing to remain competitive with their Asian counterparts. The current price level for the second quarter is €2045-2150/ton.

Downstream, there are variations from sector to sector. The shoe sole manufacturing sector has been hampered by the tightness of pure MDI supply after the force majeure declaration by Huntsman. This has reportedly led to some restriction in manufacturing capability, which will also have had an effect on BDO volume.

PBT demand remains subdued by the declining fortunes of the automotive sector in Europe. Automotive and electric/electronic end uses markets as well as other minor end uses markets have been hard hit principally because of poor economic conditions in the Eurozone and manufacturers have had to scale down production levels. Therefore, demand has gradually fallen away in recent years for PBT and its compounds in the region too.

European car sales rose for the first time in 19 months in April, according to the European Automobile Manufacturers' Association. ACEA reports it has counted on average two more working days compared to April 2012, which, it says, would account for the increase. However, it can also be attributed to continuing strong demand in the UK (+14.8%) with the market also expanding in Germany (+3.8%) and Spain (+10.8%) in April. Although April's registrations have increased by 1.7% to 1.04 million compared to a year ago, new registrations in the first four months of this year are 7.1% less than the same period last year when 4.3 million cars were registered.

**West Europe - Bio-based**

German specialty chemical firm, Lanxess, in partnership with US renewable chemicals company Genomatica, announced on 25 June that Lanxess has produced biobased PBT at its 80 ktpa co-owned petro-based PBT production facility in Hamm-Uentrop, Germany, using 20 tons of Genomatica's BDO as a raw materials. The Hamm-Uentrop PBT facility is a 50-50 joint venture between Lanxess and DuPont.

Genomatica and Lanxess said Genomatica's bio-BDO fully complied with the Lanxess specifications for petro-based BDO allowing a direct feed of 100% bio-based BDO into the facility's continuous production process. The properties and the quality of the biobased PBT produced are reportedly fully equivalent to conventional petro-based PBT with regards to all tested parameters.

***The PBT plant at Hamm-Uentrop, Germany***

Commercialized PBT is currently produced using petro-based BDO and terephthalic acid (PTA). Lanxess currently manufactures petro-based PBT and its blends under the trademark Pocan®, which is used in automotive, electronics/electrical products, lighting, household appliances, sports, etc.

Lanxess did not disclose further future plans on when it will start producing bio-PBT or if it will start sourcing bio-BDO from Genomatica for future biobased PBT production.

German chemical company, BASF, announced in May that it has licensed the bio-based 1,4 BDO processing technology of Genomatica, and plans to produce bio-BDO for testing in the second half of 2013.

BASF did not disclose the location or the size of its upcoming bio-BDO production. The company is a major manufacturer of petroleum-based BDO with facilities in Ludwigshafen, Germany; Geismar, Louisiana; Chiba, Japan: Kuantan, Malaysia; and Caojing, China. BASF's BDO production worldwide is 535 ktpa using conventional feedstocks.

It appears that BASF may construct a bio-BDO production facility with a capacity of 50 ktpa but the project is subject to market acceptance and demand for bio-BDO as the size of the plant would require a pre-existing market.

BASF intends to use bio-BDO to tap markets in which the company can create additional value for their customers, such as in the textile, automotive and plastics markets.

Genomatica's joint venture partner, bioplastic producer Novamont, is currently constructing a 20 ktpa bio-BDO facility in a recently purchased amino acid facility in Adria, Italy. Novamont expects to start operations by the end of 2013.

Novamont will finance the plant conversion and operate the facility. The company intends to consume the bio-BDO output for its own internal use as key monomer for its biopolymer products. Genomatica may purchase a portion of the production at its discretion to support further market development.

## China - Petrochemical

The Chinese BDO market was stagnant this month, although there is still a steady stream of buying enquiries. Quotations in the spot market remained firm, but numbers from some traders were heard down by Rmb100/ton in early June. In the downstream sectors, Yizheng Chemical Fibre and Lanshan Tunhe PBT facilities both resumed production gradually. June is traditionally a weak season for BDO in China, and this coupled with increased BDO capacity may result in downward price pressure later in the month.

Spot BDO was priced at Rmb13800-14100/ton, with trader prices heard at anything from Rmb14000-14200/ton. Drums and imports were respectively negotiated at around Rmb14800-16000/ton and $1850-3000/ton.

**China: BDO Import Data of April 2013**

| *Country* | *April 2013* | *Jan-Apr 2012* | *Jan-Apr 2013* |
|---|---|---|---|
| Japan | 64 | 315 | 762 |
| Holland | 1260 | 1324 | 2735 |
| Malaysia | 670 | 2418 | 2119 |
| South Korea | 0 | 809 | 780 |
| Taiwan Province | 3048 | 11340 | 6538 |
| U.S. | 0 | 1050 | 3024 |
| Saudi Arabia | 0 | 5444 | 192 |
| Germany | 5042 | 17658 | 16150 |
| **Total** | **64** | **315** | **762** |

## Asia - Bio-based

Japanese chemical firm, Toray, announced in April the successful production of molded partially bio-based polybutylene terephthalate (PBT) engineering plastic components using Genomatica's bio-BDO.

Toray has been working on bio-based PBT with Genomatica for more than two years and produced its first PBT pellets made with bio-BDO samples in February 2011. Toray said the partially bio-based PBT has physical properties and formability equivalent to PBT made with petroleum-derived BDO.

Toray plans to produce bio-based PBT at commercial scale using Genomatica's bio-BDO process. Toray said it will share samples of bio-based PBT with its customers this year to help develop market demand. Toray expects to bring products to market as soon as supplies of bio-BDO are readily available from one of Genomatica's bio-BDO licensees.

PBT is the second largest use for BDO accounting for around 25-30% of all BDO consumed worldwide or an equivalent of 700 ktpa as PBT compound. The polymer is used in wide-ranging applications from automobile parts such as switches and ignition coils to electrical parts like connectors and plugs.

Demand for PBT in China has remained weak in the last month and operating rates have been kept at low levels. Shipments of PBT resin to China were reported agreed in the first week of June in the range $1850-1900/ton cfr.

### New Bio-BDO Capacity 2012-2015

| *Company* | *Location* | *Capacity (ktpa)* | *Start-Up Date* |
|---|---|---|---|
| Genomatica/Dupont | | | |
| Tate & Lyle | California, USA | 24 (?) | Q4 2012* |
| Novamont | Adria, Italy | 16 | 2013* |
| PTT/MCC | Thailand | 50 | 2014# |
| BioAmber/Mitsui | Sarnia, Ontario, Canada | 23 | 2015+ |
| BioAmber/Mitsui | Brazil (or North America) | 50 | 2015+ |
| Myriant | Louisiana, USA | ? | ? |

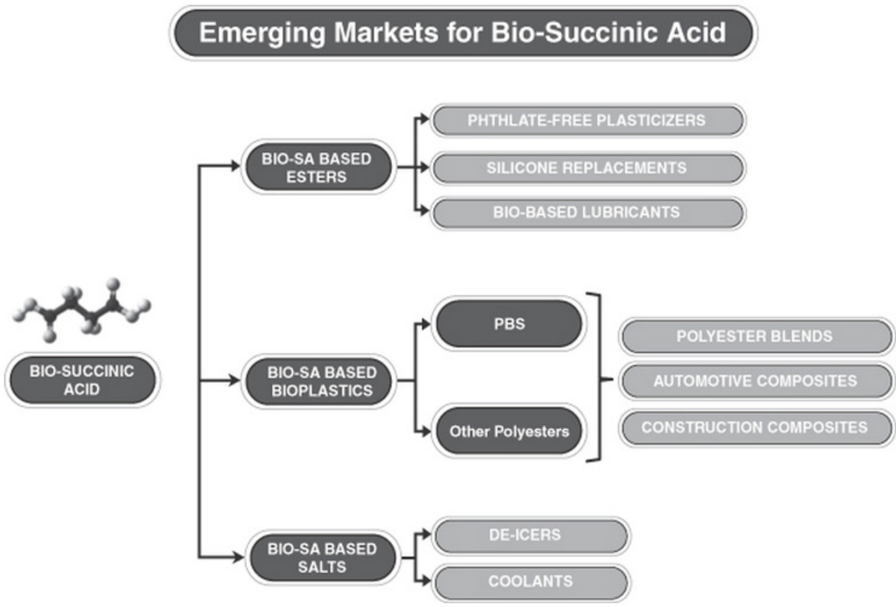
+from succinic acid
*Direct fermentation
#with PBS 20ktpa

# SUCCINIC ACID

**New Bio-Succinic Acid Capacity 2012-2015**

| *Company* | *Location* | *Capacity (ktpa)* | *Start-Up Date* |
|---|---|---|---|
| Reverdia | Cassano Spinolo, Italy | 10 | Dec 2012 |
| Myriant | Louisiana, USA | 14 | Apr 2013 |
| BioAmber/Mitsui | Sarnia, Ontario, Canada | 17 | 2013 |
| BioAmber/Mitsui | Sarnia, Ontario, Canada | 35e | 2015 |
| BASF Purac | Barcelona, Spain | 10 | early 2014 |
| BioAmber/Mitsui | Thailand | 65 | 2014 |
| BioAmber/Mitsui | Brazil (or North America) | 65 | 2015 |
| BASF Purac | Barcelona, Spain | 50e | ? |

e = Expansion of existing capacity




## North America - Bio-based

In North America, BioAmber is building a 30 ktpa bio-succinic acid plant in Sarnia, Ontario, Canada, which is expected to start operating by 2014. BioAmber already operates the world's first succinic acid plant in Pomacle, France owned by ARD, which is under exclusive use to BioAmber through a toll manufacturing agreement. As of the end of March, the plant has produced over 836 tons of bio-succinic acid since 2010 and the high purity, cost competitive bio-succinic acid is available for sale. BioAmber will move production to a global scale North American facility in 2014. The Sarnia, Ontario based plant will offer economies of scale and benefit from lower feedstock and utility costs than France, leading to a significant reduction in the price of BioAmber's bio-succinic acid.

Myriant started operation of its 14ktpa Louisiana, USA, plant in April/May 2013 and reported successful production of on-spec bio-succinic acid in June. Myriant will focus on four primary applications: biobased polymers, coatings, urethanes and plasticizers. Piedmont Chemical has said it will be using a combination of bio-succinic acid from Myriant and propanediol from DuPont Tate and Lyle Bio Products to produce renewable, sustainable polyester polyols. This renewable, 100% bio-based polyester polyol will be available by the end of the year for urethane producers seeking green polyols for their urethane products.

## West Europe - Bio-based

BioAmber has been supplying bio-based succinic acid in France through a tolling agreement with ARD since 2010 but large-scale commercial production only began in December 2012 with the start of the

Italian based Reverdia plant. Contrary to some observers' expectations, the market for succinic acid (petro and bio-based) overall in Europe does not seem long. The new bio-based production is targeted toward downstream applications of polybutylene succinate (PBS), polyester polyols for polyurethanes, coating and composite resins, phthalate-free plasticizers, and 1,4 butanediol.

Prices for petroleum-based succinic acid are reported at around $2500/ton, but this is only a provisional assessment and actual numbers may vary widely.

Succinity GmbH, the joint venture between BASF and Purac announced in October 2012 has been established in June 2013. The company's 10 ktpa bio-succinic acid plant in Spain is expected to start by the beginning of 2014. This plant is an upgrade of an existing fermentation facility at Purac's Montmélo site. An expansion to 50 ktpa is expected some time after 2015 but details on timing are not yet available.

**Asia - Bio-based**

BioAmber and Mitsui with joint venture projects already underway in North America, are now looking at Thailand as a site for future projects. A feasibility study is underway with PTT MCC (a joint venture between PTT and Mitsubishi Chemical) with a view to starting up in 2014 and a possible capacity of 65 ktpa of succinic acid and 50 ktpa of BDO. BioAmber and Mitsui are also looking at North America or Brazil for the location of a third plant of similar size.

## FATTY ACIDS

**North America - Bio-based**

Tallow is the major feedstock used for fatty acid manufacture in North America and Europe. US animal fats prices rose to historic highs in 2011 to reach a peak of $1180/ton and remained volatile last year with average prices for tallow at $960-$1030/ton. The current tallow price is at $830/ton, according to the USDA.

A major fatty acid component of tallow is stearic acid and with the volatility in tallow prices over the past two years, stearic acid pricing has also seen similar dramatic price shifts. Prices for stearic acid have been as high as $1600/ton in mid-2011 and as low as $1400/ton in late 2012. The May 2013 contract price for stearic acid is quoted between $1250/ton and $1470/ton, depending on the grade.

The May contract price for oleic acid is quoted between $1740/ton and $1830/ton. Oleic acid is found in various vegetable oils and animal fats.

The global price volatility of various fatty acid feedstocks and its corresponding fatty acid chains led to increasing developments on alternative fatty acid processing or new fatty acid feedstock sources from US renewable chemical companies such as Solazyme, OPX Biotechnologies (OPXBio), and Kiverdi.

Later this year, Solazyme will start commercial production of its algal oils that can be used as feedstock to produce tailored fatty acid chains such as high myristic and high oleic fatty acids. For chemical applications, Solazyme reported costs of producing its algal oils are around $1000/ton, which contrasts with the average selling price of triglyceride oils from coconut, palm and animal fats at between $1800/ton and $5000/ton depending on the fatty acid cuts they contain.

Solazyme expects its 100 ktpa algal oil plant in Moema, Brazil, to start operating in the fourth quarter of 2013, and its 20 ktpa plant in Clinton, Iowa, operated by Archer Daniels Midland (ADM) to start production in the first quarter of 2014.

OPXBio and Kiverdi have developed fatty acid production technologies that use gasification of biomass. OPXBio said it can create customized fatty acid chains using carbon dioxide and hydrogen from gasified biomass, solid waste or natural gas feedstocks. This development is still at the laboratory phase.

Kiverdi reports that its biochemical process using gasified waste and waste carbon produces high quantities of bio-oil, which can be used as feedstock to produce C10-C18 fatty acids and fatty alcohols. The process is modular and can be deployed locally near the source of biomass and waste gas. According to Kiverdi, the technology is still at the pilot phase and the company is looking for partnerships in the oleochemical arena.

**West Europe - Bio-based**

The expectation of price increases for palm oil and tallow is leading to firmer fatty acid price offers in Europe for third quarter contract negotiations. Europe is a major importer of palm-based fatty acids.

The contract palm oleic acid price in Northwest Europe for May was around €1000/ton ($1307/ton) cfr. The palm stearic acid price was at €950/ton, and tallow stearic acid at €940/ton.

The tallow price in Northwest Europe for May was pegged at an average of $1059/ton compared to the low of $846/ton seen in March. The palm oil price for May in the European market was estimated at an average of $845/ton; palm olein at $887/ton and palm stearin at $833/ton [the triglycerides of oleic acid and stearic acid respectively].

In recent news, Solazyme has partnered with Dutch specialty chemical firm AkzoNobel last month for the use of algal oil feedstock in surfactants, paints and coatings. Product development efforts are expected to begin in the second half of 2013.

**Asia - Bio-based**

Japanese chemical firm, Mitsui & Co., has announced early this year a $20 million multiyear partnership with Solazyme to develop a suite of triglyceride oils such as high myristic algal oils

Palm kernel oil (PKO) and coconut oil (CNO) are the dominant sources of myristic fatty acid, typically with a concentration of about 15%. Solazyme said its algal oils can now contain above 60% myristic acid. Myristic acid prices in Southeast Asia fell gradually to the current $1325/ton from a historical price peak of $4400/ton seen in April 2012.

Average domestic price of crude PKO in Malaysia last year was pegged at Myr$3249/ton ($1050/ton) while the average CNO price sourced from the Philippines and Indonesia was $1100/ton.

The CNO price in May was pegged at $793/ton while the PKO price in May was at $827/ton. The Malaysian export price for palm oil in May was $786/ton fob. This is in contrast to prices one year-ago of $1048/ton. The May export price for palm olein (the triglyceride of oleic acid) was $795/ton while palm stearin (the triglyceride of stearic acid) was $760/ton.

**Monthly Export Prices of Processed Malaysia Palm Oil (FOB US$/Ton)**

| | *Palm Oil* | *Palm Olein* | *Palm Stearin* |
|---|---|---|---|
| 2012 Average | 957 | 960 | 900 |
| Jan '13 | 792 | 802 | 689 |
| Feb | 838 | 844 | 726 |
| Mar | 799 | 805 | 720 |
| Apr | 785 | 796 | 734 |
| May | 786 | 795 | 759 |

Source: Malaysia Palm Oil Board (MPOB)

For other fractionated fatty acids, lauric acid being the largest in the market, Southeast Asia prices for the C12 cut were around $1400-$1450/ton fob. The C18 oleic acid price was around $1450/ton Southeast Asia and the C18 stearic acid price was $950/ton in Southeast Asia.

The firming feedstock palm oil price is reportedly leading to consideration of price increases for most fatty acid chains in Asia, although demand is still said to be weak especially from China, a major market for lauric and stearic fatty acids.

In China, AkzoNobel announced in March that it has exited the merchant fatty acid business in Boxing, closing down two out of three fatty acid plants at the site. China currently has 16 major fatty acid players with a total capacity of 1.67 million tpa that account for 80% of the country's hydrolysis capacity at 2.1 million tpa. The remaining 20% are mainly in the area of soap manufacturing.

## FATTY ALCOHOLS

### North America - Bio-based

Shale gas economics in North America have improved the cost position of synthetic alcohols to oleochemical fatty alcohols, although there has not yet been much shift in market dynamics. Shell and Sasol are currently the only synthetic fatty alcohol producers in North America, using ethylene and gas-to-liquids chemical routes, respectively.

As of last year, global capacity share of synthetic alcohols was 32% versus 68% from oleochemical-based alcohols. A deluge of new fatty alcohol capacity mostly coming from Asia is expected to further shrink that market share to 26% by 2015, according to the US surfactant consulting firm, Colin A. Houston & Associates.

The US fatty alcohols market is already bracing for the wave of around 740 ktpa global oleochemical-based fatty alcohol capacity coming on this year, and around 400 ktpa over the next 2-3 years.

Prices for most fatty alcohols have followed the downward trend of palm oil prices over the last 4-6 quarters. The price of C12-C15 alcohols has been dropping steadily to the current $1900/ton level, after reaching a peak of $4000/ton in mid-2011. C16-C18 alcohols prices also steadily went down to the current $1900/ton level, after reaching a peak of $2750/ton in mid-2011.

The historical volatility of fatty alcohols prices, driven by palm oil and animal fat price fluctuations, has led to developments of another alternative feedstock source:cellulosic sugar. US-based LS9 and Codexis have developed processes that use fermentation-based sugar to produce alcohols that are drop-ins to replace oleochemical-based materials.

LS9 said it is planning to commercialise its sugar-based fatty alcohols next year after successfully producing their alcohols in a 135,000-litre scale demonstration plant in Okeechobee, Florida, since Q3 2012. The company is currently eyeing Brazil as its first commercial location to build a 50 ktpa biorefinery preferably near a sugarcane mill. Codexis is targeting 2015 to start commercial production with fatty alcohols as its first product, based on the growing demand for surfactants in Latin America.

### West Europe - Bio-based

Like the US, Europe is a net importer of fatty alcohols as most natural fatty alcohol production is from palm kernel oil feedstock and most producers of this material are located in Asia. A new competitive fatty alcohol source in Europe could be a welcome change to ease a tight market and high fatty alcohol pricing seen in the region for the past two years.

US-based Codexis is hoping for a slice of this demand as the company started in June its 1,500-litre demonstration facility in Rivalta, Italy, with its partner Chemtex, an engineering and technology processing firm owned by Italian chemical company M&G Group. The fatty alcohol demonstration plant will use cellulosic sugar for feedstock.

Codexis's goal is to produce 40-60 ktpa of detergent alcohols at a future commercial facility, although specific plans for this project have not been disclosed. According to Codexis, it will take about 3.7 tons of cellulosic sugar derived from 7.4 tons of biomass to produce one ton of detergent alcohol. Most fatty alcohols end up as surfactants after being sulfonated or ethoxylated.

Singapore-based Wilmar International in partnership with US surfactant producer, Huntsman, is also expected to start production at its 150 ktpa palm-based fatty alcohol plant at Huntsman's site in Rozenburg, Netherlands, by the end of the third quarter, 2013. The plant will supply natural alcohols to Huntsman as well as to the European merchant market

Palm plantation owners, such as Wilmar and KLK have been moving beyond fatty acid production and into downstream businesses, such as fatty alcohols and surfactants to increase their margins.

Compared to the US market, the European fatty alcohols market has seen more price swings between 2011 and 2013 as the region is more sensitive to palm and oleochemical import prices. C12-C24 alcohol prices in Northwest Europe are currently around $1540/ton compared to $2400/ton seen a year-ago.

### Asia - Bio-based

**Announced New Fatty Alcohols Capacity for 2013 (ktpa)**

| *Producer* | *Location* | *Capacity* |
|---|---|---|
| Wilmar | Netherlands | 150 |
| Jiaxiang Sanjiang | China | 100 |
| KLK Oleomas | Malaysia | 100 |
| Musim Mas | Indonesia | 100 |
| Bakrie Sumatra | Indonesia | 40 |
| Wilmar | Indonesia | 150 |
| Pilipinas Kao | Philippines | 34 |
| SABIC | Saudi Arabia | 85 |

Asia accounts for 47% of the global fatty alcohols capacity as of 2012 and this market share is expected to further increase this year to over 50% with the new capacity of around 500 ktpa coming on in the region.

Indonesia's Musim Mas already started commercial production at its 100 ktpa fatty alcohol plant in Medan in April. Wilmar's 150 ktpa facility in Indonesia is expected to begin production in June. The outlook for the Asian fatty alcohols market is for a supply glut to occur in the next 2-3 years because of the upcoming capacity.

However, the Asian fatty alcohols market is currently experiencing firm-to-tight supply, especially in China because of several maintenance shutdowns. At the end of April, a Chinese producer halted production of a 220 ktpa alcohols plant due to environmental issues. Between May and July, around 160 ktpa of capacity in China is scheduled to shut for maintenance, and around 340 ktpa is expected to be down for turnarounds in several Southeast Asian alcohol facilities

The average price for C12-C14 alcohols in Southeast Asia has slightly increased to the current level of $1475/ton after bottoming out at $1310/ton in January 2013. The average price for C16-C18 cuts also increased slightly to reach the current $1385/ton, up from the $1315/ton level seen in January.

## GLYCEROL

### North America - Bio-based

The US refined glycerine (also called glycerol) price has steadily increased since December 2011, driven by healthy demand and tightening supply. The contract glycerine price is currently quoted at around $1000/ton fob, compared to around $900/ton seen in mid-2011. Pharmaceutical grades have a price premium of around $300-$600/ton over vegetable oil- and tallow-based materials.

Crude glycerine spot prices have been seen between $200/ton and $300/ton within the past year. Supply of crude product is considered ample as there are only a few refiners of crude glycerine in the US, and crude glycerine producers are inhibited by the large capital required to build new glycerine refineries. Most crude glycerine supply is sourced from the manufacture of biodiesel where glycerine is a co-product.

Improved demand for refined glycerine has been recently driven by the personal care sector as well as new uses, especially as a feedstock for monopropylene glycol (MPG) and other glycol substitutes. ADM is already producing refined glycerine-based MPG at its 100 ktpa facility in Decatur, Illinois (see report on MPG). ADM is also looking to use refined glycerine as a feedstock in the manufacture of acrylic acid. The company says it is currently producing the material in a pilot facility.

There is also a trend to develop new uses for crude glycerine materials, based on their relatively low price and ample availability. US renewable chemical company, Glycos Biotechnology, has developed the use of crude glycerine to manufacture isoprene, ethanol, and acetone. France-based METabolic EXplorer is looking to produce 1,3 propanediol (PDO) in Malaysia using crude glycerine as the feedstock.

US-based, Segetis, is already marketing its levulinic ketals that combines glycerol and levulinic acid for applications such as solvents and plasticizers.

**West Europe - Bio-based**

Contract glycerine prices in Northwest Europe rose to between €700/ton and €800/ton in late 2012 to early 2013; compared to the price range of €450-€650/ton seen in 2011. Second quarter 2013 contract glycerine price fell to €570-€650/ton, however, because of market uncertainty and improved supply.

Nevertheless, spot European vegetable glycerine prices are starting to firm, led by stronger buying interest, notably from the feed sector and also some interest from eastern Europe for anti-freeze applications. Lower biodiesel production in Europe is also tightening supplies for crude glycerine.

New uses for glycerine are also affecting market sentiment, although, late last year, refined glycerine producer Oleon suspended its bio-based MPG production at its 20 ktpa facility in Ertvelde, Belgium, in favour of selling the feedstock glycerine, as selling at the high refined glycerine price in Europe was more attractive than converting it to MPG.

Dutch specialty chemical firm, AkzoNobel, recently signed a deal with Belgium-based chemical group Solvay for the supply of refined glycerine-based epichlorohydrin (ECH) between 2013 and 2016. Under the deal, AkzoNobel will guarantee to buy volumes of glycerine-based ECH indirectly via the epoxy resins it purchases from Solvay's customers. Solvay's glycerine-to-ECH process technology is marketed under the trademark Epicerol®.

AkzoNobel said it will progressively increase the use of Epicerol®-based ECH, which is already contained in many of the company's resins for its coatings products. By 2016, AkzoNobel aimed to source 20% of its total ECH demand as bio-based material.

Solvay currently has a 20 ktpa Epicerol-based production at Tavaux, France, and a 100 ktpa operation in Map Ta Phut, Thailand, operated by its affiliate Vinythai. The Tavaux facility consumes 22 ktpa of refined glycerine sourced from Europe, and the Map Ta Phut facility consumes 110 ktpa of refined glycerine, contracted in Asia.

Netherlands-based bio methanol producer BioMCN has developed a process for making bio methanol from crude glycerine and is already producing at a 200 ktpa facility in Delfzijl. The company plans to restart the No. 2 plant at Delfzijl in 2015; initially with another 200 ktpa of bio methanol capacity and then expanding to 400 ktpa by 2016.

**Asia - Bio-based**

Asia is becoming the epicentre of new glycerine market applications as several glycerine-based projects have been announced, while epichlorohydrin manufacture, using refined glycerine feedstock, is already a commercial success.

Solvay's glycerine-to-ECH Epicerol® process technology already consumes 110 ktpa of refined glycerine within the Asia market. The company is currently constructing an additional 100 ktpa capacity in China, which is expected to start operating in the second half of 2014.

1,3 propanediol (PDO) is another market opportunity for glycerine as three companies - France-based METabolic EXplorer; China-based Zhangjiagang Glory Biomaterial; and the Shenghong Group race to compete with current bio-PDO and bio-PTT (polytrimethylene terephthalate) fibre producer, DuPont.

PTT is made from 1,3 PDO and terephthalic acid. Unlike the above three PDO projects, DuPont's 1,3 PDO uses corn as feedstock. A DuPont official acknowledged the incoming glycerine-based PDO projects but noted that glycerine price and supply have historically been volatile, which could leave DuPont advantaged in terms of feedstock costs.

Glycos Biotechnologies is also using crude glycerine feedstock to produce the rubber raw material, isoprene, as well as ethanol and acetone. The company's biorefinery, being built in a Malaysian industrial park called Bio-Xcell, is expected to start operating this year with a production capacity of up to 30 ktpa, which is expected to be reached by 2014. The biorefinery can reportedly expand to a capacity of 90 ktpa, depending on market demand.

Crude glycerine spot prices in Asia were assessed as stable-to-soft and currently quoted at around $400/ton. Average refined glycerine prices in China and Southeast Asia were seen at $910/ton and $885/ton, respectively.

**China: Glycerol Imports By Leading Source Countries April 2013 (Metric Tons)**

| *Country* | *April 2013* | *Jan-Apr 2012* | *Jan-Apr 2013* |
|---|---|---|---|
| Indonesia | 3949 | 27070 | 15447 |
| Malaysia | 3796 | 18132 | 13093 |
| Philippines | 167 | 459 | 534 |
| Australia | 101 | 594 | 499 |
| Japan | 20 | 78 | 73 |
| U.S. | 5 | 12 | 23 |
| France | 0 | 822 | 0 |
| Argentina | 0 | 1245 | 0 |
| Thailand | 0 | 1592 | 0 |
| **Total** | **8043** | **50031** | **29705** |

Source: China Customs

## POLYLACTIC ACID (PLA)

### North America

US polylactic acid (PLA) resin producer, NatureWorks, a 50-50 joint venture between US agribusiness Cargill and Thailand chemical firm PTT, has selected Cromex as its Brazilian distributor for its Ingeo® PLA-based fibers and plastics.

NatureWorks noted that its Ingeo® food service items, such as flatware, cups and utensils, are typically biodegradable in industrial composting facilities. Rigid and film-based Ingeo® packaging reportedly delivers performance advantages. A PLA-based clamshell packaging that requires 20-30% less material than a comparable package made from PET illustrates one of these advantages.

NatureWorks is the largest PLA producer worldwide with a current 150 ktpa production facility located in Blair, Nebraska, USA. According to a recent biopolymers study from Germany-based Nova-Institut, 25 companies are currently producing PLA with a total of over 180 ktpa capacity located at 30 sites worldwide. In addition to the Nature Works facility, other producers have current capacity ranging from 1.5 ktpa to 10 ktpa. Nova-Institut has forecast global PLA capacity will reach 800 ktpa by 2020 with at least seven sites having a capacity of over 50 ktpa by that year.

In the US, only one other PLA producer, HEPLON American Chronopol, has been reported with a 2 ktpa capacity located in Colorado, USA. Most of the planned PLA facilities will be located in Asia.

As the PLA market remains a niche plastic sector with few major players, pricing for PLA resins remains difficult to pin down. PLA's feedstock, lactic acid, however, has long been traded in the commercial market for various applications, such as in the food and beverage sector as a preservative and pH adjusting agent and in the pharmaceutical and chemical industries as a solvent and intermediate material. Polymerization of lactic acid produces the biodegradable polylactic acid polymer.

Market prices for lactic acid were estimated between $1300/ton and $1600/ton. Industry sources indicated pricing for PLA to compete against PP and PET could be around $2000/ton, although competing materials pricing varies, depending on applications. PLA has increasingly been used in blends with other bioplastics such as starch-based resins or with traditional polyolefins.

**West Europe**

Swiss engineering firm Sulzer has been contracted to deliver a 10 ktpa PLA plant in Asia using its proprietary PLA processing technology. The facility is expected to start in the second half of 2014. The company did not disclose the name of its customer or the location where the PLA plant will be constructed.

Sulzer started its own 1 ktpa PLA pilot plant last year, mostly for customer testing. Another European engineering firm, Uhde, is also operating a 500 tpa PLA pilot plant in Guben, Germany, for customer trials.

In April, Russian industrial biotechnology company, PoliKompleks, is reportedly planning to construct a PLA-based plastic facility in Kaliningrad with a capacity of 50 ktpa. The project is expected to be completed in 2016.

Other PLA producers in Europe include Synbra Technology based in the Netherlands and Futerro, a 50-50 joint venture established in 2007 by lactic acid producer Galactic and Total Petrochemicals. Synbra is currently running a 5 ktpa PLA capacity at the Sulzer Chemtech facility in Allschwil, Switzerland. The PLA plant, which started operations in 2011, is based on a new polymerization process jointly developed by Sulzer and Dutch lactic acid producer, Purac. Customers of Synbra are manufacturers of packaging and insulation products.

Futerro has a 1.5 ktpa demonstration unit in Escanaffles, Belgium, mostly for PLA testing.

**Asia**

NatureWorks is still deciding on the exact location of its proposed second PLA plant planned for Asia, which it is understood to be aiming to start up by 2016.

Asia's PLA demand is projected to grow at 20-25% from 2013 to 2015. NatureWorks said it is expected to make a decision on the location of the new plant in the second half of this year.

NatureWorks also announced in May that it has chosen PTT Polymer Marketing Co. Ltd. (PTTPM), the marketing arm of PTT Global Chemical as its distributor of Ingeo® resins in Thailand and Vietnam.

A 10 ktpa PLA facility is expected to start up in the second half of 2014 somewhere in Asia , according to Sulzer, which has been contracted to build the facility. The target PLA market for this undisclosed Asian PLA producer is on high heat PLA for durable and precision applications such as for automotive and electronics parts.

Lactic acid producer, Purac, was contracted to deliver up to 10 ktpa of its PURALACT lactides for this facility. Purac started operating its new 75 ktpa lactic acid plant in Rayong, Thailand, last year. Purac reports it has also signed a development agreement with an undisclosed Asian partner that will further accelerate commercialization of PLA compounds for injection molding and extrusion purposes.

In China, Hisun Chemical announced in January 2012 that it is planning to expand its PLA capacity in Taizhou, Zhejiang to 50 ktpa. The newly expanded facility is expected to start operating this year. China's PLA production cost is typically higher compared to that of NatureWorks with some domestic industrial PLA resins reportedly reaching prices of up to $4000/ton, depending on the region and the end-use. PLA use in biomedical applications, which is usually imported, is quoted at prices as high as $10000/ton.

**PLA import data for key markets April 2013 (Metric Tons)**

| *Country* | *April 2013* | *Jan-Apr 2012* | *Jan-Apr 2013* |
|---|---|---|---|
| China | 899 | 2281 | 2488 |
| Taiwan | 989 | 3854 | 2929 |
| South Korea | 429 | 884 | 1861 |
| Japan | 302 | 2005 | 1518 |
| U.S. | 76 | 868 | 260 |
| France | 29 | 489 | 383 |
| Netherlands | N.A. | 5070 | *2751 |
| Italy | N.A. | 2438 | *2273 |
| Germany | N.A. | 2195 | *2784 |
| EU27 | 1175 | 6231 | 5550 |

* These are Jan-Mar 2013 import data as April are not available

## AGRICULTURAL SECTOR FEEDSTOCK NEWS

Fats and oils prices worldwide have eased from record high levels seen in mid-2011 to mid-2012. This decline in prices has been driven by weaker global demand for most fats and oils from mid-last year, as well as by an expectation of higher global production of major vegetable oils, palm oil and soybean oil this year. Global soybean production for crop year 2013/14 (starting in September) is expected to increase 6% to 285.5 million tons, according to the US Department of Agriculture (USDA). Global production of palm oil is projected up 5% to 58.1 million tons. World production of tallow is seen stagnating at 8.3-8.4 million tons in marketing year October 2012/September 2013.

**Fats and Oils Price (Northwest Europe, US$/ton)**

| *Products* | *April* | *May* | *Jan-May 2013* | *Jan-Dec 2012* |
|---|---|---|---|---|
| Crude palm oil | 842 | 849 | 850 | 1,000 |
| Soybean oil | 1,095 | 1,074 | 1,130 | 1,227 |
| Rapeseed oil | 1,136 | 1,116 | 1,171 | 1,241 |
| Coconut oil | 793 | 826 | 826 | 1,112 |
| Tallow | 1,073 | 1,059 | 1,035 | 1,087 |

Source: Asian and Pacific Coconut Community (www.apccsec.org)

Corn and corn derivatives prices worldwide are also coming down from record highs seen in mid-2012. Record global corn production for crop year 2013/14 that starts in September is expected to exert substantial downward pressure on prices. Global corn production is forecast up 13% to 109 million tons on the basis of record crops in the US, Argentina, China and Ukraine.

The US is the world's largest producer and exporter of corn. The US corn crop for 2013/14 is projected at a record 14.1 billion bushels, 3.4 billion above last season's drought-reduced crop. U.S. corn prices are projected sharply lower, with the 2013/14 midpoint of the price range down 32% on same time last year at $4.70 per bushel. [For corn (maize), 1 bushel = 56 lbs = 25.4 kg]

World corn imports are expected to be stronger with most of the additional demand coming from China. Corn used for ethanol in the US is up from last year although forecast lower than the peak seen two years ago.

**US Corn and By-products Prices**

| *Month* | *Corn ($/bushel)* | *Corn starch ($/ton)* | *Dextrose ($/ton)* |
|---|---|---|---|
| Jan. 2012 | 6.25 | 438.72 | 768.31 |
| Feb | 6.41 | 471.79 | 746.26 |
| Mar | 6.46 | 480.39 | 790.36 |
| Apr | 6.34 | 487.00 | 768.31 |
| May | 6.27 | 470.47 | 768.31 |
| Jun | 6.30 | 468.48 | 768.31 |
| Jul | 7.85 | 455.25 | 779.33 |
| Aug | 8.15 | 531.31 | 768.31 |
| Sep | 7.70 | 533.96 | 768.31 |
| Oct | 7.48 | 508.16 | 768.31 |
| Nov | 7.39 | 490.31 | 779.33 |
| Dec | 7.23 | 490.97 | 773.82 |
| Jan 2013 | 7.17 | 502.21 | 779.33 |
| Feb | 7.15 | 490.97 | 779.33 |
| Mar | 7.33 | 502.87 | 779.33 |
| Apr | 6.57 | 508.83 | 779.33 |
| May | 6.83 | 484.36 | 779.33 |

For corn (maize) 1 bushel = 56 lbs = 25.4 kg
Source: US Department of Agriculture

**US Corn Industrial Use (Million Tons)**

| *Marketing Year* | *Glucose and Dextrose* | *Starch* | *Fuel Alcohol* |
|---|---|---|---|
| Sep-Nov 2011 | 1.98 | 1.64 | 32.18 |
| Dec 2011-Feb 2012 | 1.86 | 1.58 | 33.14 |
| Jun-Aug 2012 | 1.84 | 1.65 | 31.70 |
| Sep-Nov 2012 | 1.79 | 1.62 | 29.00 |
| Dec 2012-Feb 2013 | 1.65 | 1.49 | 28.40 |

Source: US Department of Agriculture

Sugar and ethanol prices are expected to come down this year as the 2013/14 sugarcane harvest year in Brazil, which started in April, is forecast to increase by 8.3% at 640 million tons over the 2012/13 crop of 591.1 million tons, according to the Brazilian sugarcane industry association, UNICA. Ethanol production is projected higher at 26.82 billion litres: 12.55 billion litres for anhydrous ethanol and 14.27 billion litres for hydrous. Hydrous (or wet) ethanol is the most concentrated grade of ethanol (96%) that can be produced by simple distillation, without the further dehydration step necessary to produce anhydrous (or dry) ethanol.

Anhydrous ethanol production is expected to increase the most because of the increase in the blend requirement to 25% (E25) for gasoline sales. Although 90% of all vehicles sold in Brazil are flex-fuel, hydrous ethanol prices in Sao Paulo State alone seem consistently low enough to favour ethanol use over gasoline.

The average export price for Brazilian ethanol in April was $703/litre ($2.67/gal), a decrease of 5% from one year ago. Export Brazilian ethanol prices peaked in February 2012 at $3.11/gal and went as low as $2.39/gal in December 2012. Prices for export Brazilian sugar peaked at $582/ton in April last year and continuously went down to hit $460/ton in April this year, down 21% compared to the price one year earlier.

## ECONOMIC NEWS

US building permits for privately-owned housing have fallen by 3.1% in May to a seasonally adjusted rate of 974,000 but it is 20.8% above the May 2012 estimate of 806,000. Housing starts in May were at a rate of 914,000, 6.8% above the revised April estimate of 856,000 and 28.6% above May 2012.

The final Markit US Manufacturing Purchasing Managers' Index (PMI) signalled a further improvement in May with a reading of 52.3, up slightly from the six-month low of 52.1 in April. Production levels increased in May as the number of new orders rose in the domestic market, whereas new export orders have changed little over the month.

The unemployment rate in the Eurozone was 12.2% in April, up from 12.1% in March. In the EU27, the unemployment rate was unchanged in April at 11.0%. In both zones, rates have increased compared to April 2012 when they were 11.2% and 10.3% respectively, according to Eurostat.

Total US nonfarm payroll employment increased by 175,000 in May. Both the number of unemployed persons, at 11.8 million, and the unemployment rate, at 7.6%, were unchanged in May, the US Bureau f Labour Statistics has reported,

The Organisation for Economic Co-operation and Development (OECD) has again cut its growth forecasts for the Eurozone, saying that it will shrink by 0.6% this year, with the UK forecast revised down to 0.8% growth this year and 1.1% in 2014. In its twice-yearly Economic Outlook, the OECD reports US activity is projected to rise by 1.9% this year and by a further 2.8% in 2014 and in Japan GDP is expected to grow by 1.6% in 2013 and 1.4% in 2014. It also expects China's annual growth to be about 8% over the next two years.

GDP in the Eurozone fell by 0.2% and by 0.1% in the EU27 in the first quarter of 2013, compared to the previous quarter, according to a second estimate by Eurostat. In Q4 2012, growth rates were down by 0.6% and 0.5% respectively. Compared to Q1 2012, GDP has fallen by 1.1% in the Eurozone and by 0.7% in the EU27.

The Bureau of Economic Analysis (BEA) has released its "second" estimate of real GDP growth in the US, reporting it has increased at an annual rate of 2.4% in the first quarter of 2013 compared to Q4 2012. The data is based on more complete source data, which was not available for the "advance" estimate in April (+2.5%). The BEA reports the "second" estimate has taken into account that increases in private inventory investment, both in exports and in imports, were less than previously estimated, but the general picture of overall economic activity has not greatly changed.

In China, the Producer Price Index (PPI) for manufactured goods fell in May by 2.9% year on year and 0.6 % from last month, according to the National Bureau of Statistics of China. From January to May the PPI for manufactured goods decreased 2.3% year on year. The Consumer Price Index (CPI), however, has gone up by 2.1% year on year but it is down by 0.6% from last month.

US light-vehicle sales totalled 1.4 million in May, up from April's figure of 1.28 million, according to Wards Auto. Annual sales of 15.2 million mark an increase from April's 14.9 (when sales had hit the lowest since October last year). Sales have been driven by large trucks and cross/utility vehicles followed by sales in the lower-small and lower-luxury sector.

Demand for new passenger cars in the EU fell in May to their lowest level since 1993, dropping by 5.9% to 1,042,742 units from April. In the first five months of this year, new cars registered in the region were 6.8% less year on year. Most of the major markets faced a downturn in May ranging from -2.6% in Spain, to -8.0% in Italy, -9.9% in Germany and -10.4% in France. The UK is once again the only country to have posted growth at +11.0%.

In China, 1,396,900 passengers cars were sold in May, 3.09% down from April but they are up 9.04% compared to the same period last year, according to the China Association of Automobile Manufacturers (CAAM). From January to May, passenger car sales have increased 14.73% year on year to about 7,261,600 units.

Car sales have fallen for the seventh consecutive month in India despite the high discounts on offer, according to the Society of Indian Automobile Manufactuers (SIAM). Data shows that car sales fell 12.3% year on year in May with a total of 143, 216 cars sold. The association now expects job losses as poor sales are forcing manufacturers to cut back production.

# CHEMICAL PROFILE: POLYBUTYLENE SUCCINATE (PBS)

## Introduction

Polybutylene succinate (PBS), a biodegradable plastic used in applications such as packaging for food and consumer electronics, tableware, agriculture mulch films and civil engineering materials, has attracted lots of interest and is under development for numerous applications worldwide. Due to its aliphatic nature, the hydrolysable ester bonds within its structure are relatively accessible for microbial degradation. Hence, PBS decomposes into carbon dioxide and water in a natural environment. PBS is regarded to have good thermal stability relative to other types of biodegradable polymers, with melting point at about 95 - 115 °C. It can also be blended with other biodegradable materials such as starch and polylactic acid (PLA) up to special modification to enable commercial application for different kinds of plastic products.

## Processing Technology

At the moment, PBS is mostly synthesized via one-step polycondensation of petro-derived succinic acid and 1,4 butanediol (BDO). The two Japan-based chemical companies Showa Denko and Mitsubishi Chemical are the only known producers currently making commercial quantities of PBS using bio-based succinic acid and petrochemical-based BDO. Myriant is the supplier of renewable-based succinic acid for Showa Denko's PBS while Mitsubishi Chemical's bio-based succinic acid is supplied by BioAmber. Potentially PBS can be made 100% bio-based if the BDO part is made from renewable rather than petrochemical feedstock. Bio-based BDO can be produced via a one-step direct fermentation (route by Genomatica), or alternatively via a two-step process consisting of the initial production of succinic acid from bio-feedstocks and subsequent conversion to BDO through conventional hydrogenation.

## Top Petrochemical Producers (ktpa)

| *Company* | *Location* | *Capacity* |
|---|---|---|
| Mitsubishi Chemical | Japan | 3 |
| Showa Denko | Tatsuno, Japan | 6 |
| Samsung Fine Chemicals | Korea | 2 |
| Kingfa Science&Technology (via Zhuhai Wantong Chemical) | China | 30 |
| Zhejiang Hangzhou Xinfu Pharmaceutical | China | 20e |
| Anqing Hexing Chemical | Anqing, Anhui, China | 10 |
| China New Materials | Zibo, Shandong, China | 25 |

e = Expansion of existing 13 ktpa capacity expected by September 2013

## Planned Bio-based Capacity (ktpa)

| *Company* | *Location* | *Capacity* | *Start-up Date* |
|---|---|---|---|
| PTTMCC | Rayong, Thailand | 20 | 2015 |

## Market Fundamentals

A joint venture of PTT Thailand and Mitsubishi Chemical (called PTTMCC Biochem) is building a PBS plant in Thailand with an annual capacity of 20,000 tons and production is targeted to come on stream by 2015. BioAmber has been chosen as a partner to build a succinic acid plant with capacity of 65 ktpa in proximity to PTTMCC's PBS plant. BioAmber also plans to produce 50 ktpa of bio-based BDO on site, using DuPont's hydrogenation catalyst technology to convert bio-based succinic acid to BDO in an integrated process. According to BioAmber, PTTMCC will help BioAmber secure the sourcing of biomass for the plant (initially from sugar cane and/or tapioca). Mitsubishi Chemical is currently producing petroleum-based biodegradable PBS in Japan under the brand GS Pla. Mitsubishi Chemical has also signed an agreement with automotive equipment supplier Faurecia on joint research and development of a 100% renewable-based polymer suitable for automotive interior parts. The project will begin by modifying Mitsubishi Chemical's patented bio-based PBS, targeted to be produced from 100% biomass feedstock. BioAmber will also be the supplier of succinic acid in this partnership.

**Prices**

The Chinese PBS market is strong with good demand for petroleum-based material, which is priced at around $4500/ton, after discounts. A premium for bio-based material may not be viable as the existing material has a green aspect to it, already, being bio-degradable.

**Research & Development**

Much research and development interest has been focused on blending PBS with other copolymers with complementary properties to expand the range of commercial applications, such as compounded PLA/PBS. PLA is a biodegradable polymer derived from renewable resources such as corn starch. Although it has great potential because of the increasing interest in the global environment, its application is restricted by the limited thermal and mechanical properties of virgin PLA. Research has been done to investigate blending of PBS with PLA in order to improve the toughness of PLA, while maintaining its sustainability.

NatureWorks, with its commercial range of Ingeo™ PLA biopolymers, has formed a joint venture called AmberWorks with BioAmber to commercialise bio-based compounded PBS. The PLA/PBS compounding intellectual property used by AmberWorks is owned by Sinoven Biopolymers, a subsidiary of BioAmber.

NEXT PRODUCT PROFILE: BIO-SUCCINIC ACID

FUTURE PRODUCT PROFILE: BIO-1,4 BUTANEDIOL

## STUDIES

Tecnon OrbiChem's S/Db-CHEM is a truly comprehensive service, containing all the information you need - Supply/Demand data, Trade flows, Consumption trends, Capacity listings and Historical prices.

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## CONFERENCES

**10th China International Polyester & Intermediates Forum**
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