

ATTACK PACK POLYURETHANE

DATE: 31-05-2013	INDUSTRY: Polyurethane	STATUS:
WANNER <i>Hydra-Cell</i> Seal-less Pump Technology		

PROTECTED

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INTRODUCTION

Polyurethane (PU) is one of the most frequently used polymer materials after the so-called standard plastics (polyolefins, PVC, polystyrene).

Optimal production conditions have to be available so that the advantages provided by polyurethane materials come into their own. The product quality depends on the mixing process of the high-viscosity basic components and additives. There are thousands of commercial formulae each with specific performance attributes.

Because of Hydra-Cell's unique performance capabilities, we have excellent opportunities with manufacturers and repairers of Polyurethane machines.

Typical areas of opportunity are:

- Base chemical manufacturers
- Equipment manufacturers
- PU producers (point of use)

On the CD you will find a list of Polyurethane Machine Manufacturers in your territory. Necessarily, this list is not comprehensive. Please supplement it from your records, your knowledge of the market and other local sources. We have had significant success in selling Hydra-Cell pumps in PU foam applications and market dynamics are moving in our favour.

Many thanks

Nick Herrington
Marketing & Technical Support
Wanner International

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THE PROCESS

The Chemistry

The main ingredients of PU foams are Polyols and Isocyanates. To these are added an array of chain extenders, fillers, catalysts, surfactants, blowing agents and crosslink agents in order to achieve specific characteristics.

The Problems:

Polyols vary widely in viscosity. They can be very abrasive, especially when filled, and can cause excessive wear in pumps with mechanical seals. Hydra-Cell has no mechanical seals. The pressure requirement can also vary widely according to the chemical composition of the finished material. Hydra-Cell can handle a wide range of pressure requirements.

Isocyanates tend to crystallise if and when they come into contact with air... a problem for pumps with dynamic seals. Toluene Diisocyanate (TDI) is a class B poison and extremely hazardous. It can cause severe asthmatic reactions and sensitization. For this reason, 100% containment is essential and leaking shaft seals can be the source of serious problems. Hydra-Cell has no dynamic seals in contact with the pumped material.

Additives such as Amines, Silicone, Catalysts (C1, C2 and C3), water, acids and Phenolic resins can be abrasive, corrosive and non-lubricating, yet need to be metered and dosed very precisely.

So significant is the seal wear problem that a major competitor has introduced a line of pumps specifically for PU manufacture, with provision for "easy installation and replacement of these seals".

Blowing Agents such as pentane, 1,1,1,2-tetrafluoroethane (HFC-134a) and 1,1,1,3,3-pentafluoropropane (HFC-245fa) are non-lubricating fluids. They require refrigeration and high inlet pressures in order to remain liquid.

Hydra-Cell pumps can handle inlet pressures greater than 18 Bar and their small footprint enables them to be installed in smaller refrigeration units resulting in equipment, maintenance and operational savings.

Having no dynamic seals, Hydra-ell pumps offer no potential leak paths for vapours.



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THE MACHINE TYPES

The Machines

FIPFG (Form in Place Foam Gasket) Machines



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THE MACHINE TYPES

The Machines

Spray Coating / Filling Machines (Can be fixed or mobile)



Moulding Machines (RIM)



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THE MACHINE TYPES

The Machines

Slab Stock Machines (Continuous)



Foaming Machine Tracks (285 metres long)

Intermittent (Discontinuous)



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Foam-Forming Technology

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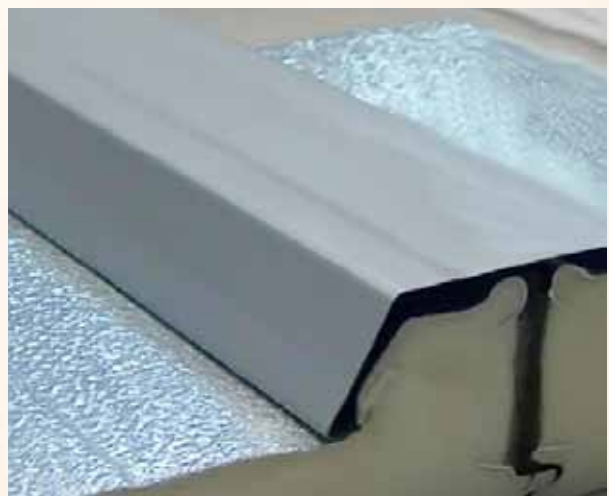
THE MACHINE TYPES

The Machines

Laminated Sandwich Panel Machines (Continuous)



(Discontinuous)



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THE OPPORTUNITIES

The Hydra-Cell Opportunities:

1) Transfer of Polyols and Isocyanates from storage tanks to day tanks.

Hydra-Cell Benefits:

- Hydra-Cell handles abrasives better than gear, lobe and progressive cavity pumps
- Hydra-Cell has no dynamic seals... no seal maintenance requirement.
- Hydra-Cell has no dynamic seals through which air can ingress.
- Hydra-Cell can run dry without damage... resistant to operator error and can empty tanks completely.
- Hydra-Cell can handle viscosities up to 5000 cPs.
- Hydra-Cell can handle high pressure requirements up to 170 bar to overcome long transfer lines.



2) Additive Injection

Corrosive and non-lubricating additives can be injected accurately in a measured stream at high pressure with Hydra-Cell pumps.

Hydra-Cell Benefits:

- Multi-diaphragm pump head, compact design – saving production space.
- Multi-diaphragm pump head, smooth virtually pulse-less flow gives more accurate control over dosing.
- Multi-diaphragm pump head, smooth virtually pulse less flow removes the need for pulsation dampers.
- No dynamic seals – No seal maintenance when pumping corrosive, abrasive, non-lubricating liquids.



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THE OPPORTUNITIES

3) Blowing Agents

Pentane is the most common blowing agent in use. It is non-lubrication and has a high vapour pressure so the process temperature needs to be kept low.

Hydra-Cell Benefits:

- Multi-diaphragm pump head, compact design – Saves production space, and reduces cooling costs.
- Multi-diaphragm pump head gives smooth, virtually pulse less flow enabling more accurate control over dosing.
- Multi-diaphragm pump head, smooth virtually pulse less flow removes the need for pulsation dampers.



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THE OPPORTUNITIES

API 675

Meeting the performance standards of API 675, Hydra-Cell pumps are highly accurate and repeatable; ideal for dosing and injection duties.

Wanner International has invested in a dedicated test facility that enables customers to verify performance of individual pumps. Independent witnessed and non-witnessed testing is available, followed by performance certification.

The service is optional but is already reassuring users that Hydra-Cell metering pumps can meet or exceed their performance requirements. A more accurate knowledge of pump performance can often be a critical element in process optimization and the reduction of operating costs.



PTFE Diaphragms

The new PTFE diaphragms for Hydra-Cell Go3, Go4, P200 and P300 models were initially developed to meet the needs of polyurethane manufacturing and are resistant to the wide range of chemicals additives and blowing agents used in the production process.

They have been tested extensively and shown to operate reliably at full flow, under flooded inlet conditions. With a service life now extended to 240 million cycles (4000 hours at 1000rpm) these new diaphragms are responsible for Hydra-Cell's increasing acceptance as THE pumps for metering, dosing and injection in polyurethane production.



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THE OPPORTUNITIES

Pump Speed Adjustment and Control

In polyurethane production, accurate metering of components and additives is essential.

Wanner International now offers two speed control systems, one mechanical and one electronic, that enable precise adjustment of shaft speed and hence pump flow.

1. Mechanical Adjust Speed Control

Range of ATEX approved, mechanical, torque-proportional power transmissions for long service life and high reliability.

- Linear setting characteristics down to zero speed
- Transmits the highest torques, even at low output speeds
- Elastohydrodynamic power transmission prevents mechanical slippage
- Models to suit Hydra-Cell P200, P300, P400, P500 and P600



2. Electronic Adjust Speed Control

Variable Frequency Drive with integrated AC induction motor in a compact, low weight unit.

- Local analogue control, graded 0 to 100%
- Fully integrated system... Pump, Motor and Inverter
- IP65, Class F with ATEX approval
- Suitable for Hydra-Cell P200



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Each Area Pumping Technology

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THE OPPORTUNITIES

Polyurethane Manufacturers

Profitable business can be gained, not only with PU machine manufacturers but also with the end users of those machines... Those companies that actually make the polyurethane foam. Make a list of the potential users in your area and follow it through.

To help in making that list, here are some examples of the types on industries making polyurethane foams with specific applications.

Building & Construction

Form liners & concrete moulds
Rigid foam insulation panels
Foam seals

Automotive

Car body kits
Automotive interiors, eg. car seats, headrests, armrests, roof liners, dashboards and instrument panels

Packaging

Foam padding and specialist retail packaging
Insulated double skinned totes

Machinery & Foundry

Microcellular foam seals and gaskets (Formed in Place)

Marine

Boat decks and rigid-hulled boats
Surfboards

Furniture & Bedding

High resiliency flexible foam seating
Mattress padding and solid-core mattress cores
Carpet underlay
Upholstered furniture cushions

Textiles, Fibers, Apparel & Footwear

Tennis racquet grips
Shoe insoles

Custom Transfer Moulders

Composites Manufacturers

Composite Foam cores
FRP Boat building cores
Sports equipment cores

PU Foam Manufacturers

Such as Vitafoam, Recticel, Metzler, Carpenter, Mewett, Airex, BASF, etc

THE BENEFITS

Hydra-Cell Benefits vs Magnetic Drive Pumps

Magnetic Drive Pump	Hydra-Cell®
• Cannot run dry without damage to the pump	• Seal-less design enables Hydra-Cell to run dry without damage
• Requires monitoring to ensure fluid flow	• Ensures proper fluid flow without monitoring
• Designed to pump clean, low-viscosity fluids	• Seal-less pumping chamber and spring-loaded, horizontal disk check valves can handle particulates and abrasive fillers
• Higher power requirements and energy costs	• Low-shear pumping action handles higher viscosity fluids
• Can have a long horizontal footprint with higher acquisition and replacement costs	• Smaller footprint compared to some magnetic drive pumps • More energy efficient • Easier to service • Lower acquisition, operating and replacement costs

Hydra-Cell Benefits vs Internal Gear Pumps

Internal Gear Pump	Hydra-Cell®
• Mechanical seals and packing require maintenance, and replacement or adjustment	• The seal-less design of Hydra-Cell means that there are no seals or packing to leak or replace
• Does not tolerate thin/non-lubricating liquids, and does not handle solids, abrasives or particulates well	• Seal-less pumping chamber and spring-loaded, horizontal disk check valves can pump solids, abrasive fillers and particulates while handling liquids thick or thin
• Designed for operating at low speeds and low pressure ratings • Low volumetric efficiency	• Operates at low-to-high speeds and at higher pressures with higher volumetric efficiency
• Component wear reduces accuracy and efficiency	• No internal gears to wear so there is less maintenance and spare part replacement • Accuracy and efficiency are more stable
• One bearing runs in the pumped fluid	• No bearings in the pumped fluid
• Unbalanced - overhung load on the shaft bearing	• Hydraulically balanced design so there is no overhung load

THE BENEFITS

Hydra-Cell Benefits vs External Gear Pumps

External Gear Pump	Hydra-Cell®
Mechanical seals and packing require maintenance, and replacement or adjustment	The seal-less design of Hydra-Cell means that there are no seals or packing to leak or replace
Does not tolerate solids, abrasives, or particulates	Seal-less pumping chamber and spring-loaded, horizontal disk check valves can pump solids, abrasive fillers and particulates
Component wear reduces accuracy and efficiency	- No internal gears to wear so there is less maintenance and spare part replacement - Efficiency is more stable
Contains four bushings in the fluid area	No bushings in the pumped fluid
Fixed end clearances	Design does not rely on clearances
Efficiency drops over 103 bar	Efficiency remains relatively constant over its range of operating pressures

Hydra-Cell Benefits vs Axial Piston Pumps

Axial Piston Pump	Hydra-Cell®
Tight tolerances prevent use in fluids with particulates greater than 7 microns, especially with liquids (e.g. Isocyanates) that react with air and form crystals in the liquid	Tolerances are not an issue because the seal-less design and spring-loaded, horizontal disk check valves enable Hydra-Cell to pump solids, abrasive fillers and particulates up to 500 microns or more in diameter
Filter and fluid reservoir necessary to maintain fluid cleanliness	Inherently simple design separates the lubricating film from the pumped liquid
Cylinder barrel can separate from valve plate, causing loss of lubricating film and damage to the barrel or plate	Requires no external filtration of pumped fluids
Back pressure can cause seal failure and mechanical damage	No packing and seal-less design, so it will not leak from seal failure

THE BENEFITS

Hydra-Cell Benefits vs Traditional Metering Pumps

Traditional Metering Pump	Hydra-Cell®
• Use manual stroke adjusters or expensive actuators to control flow, which can result in pumping inaccuracies, lost motion, operator error, and a greater chance of leakage	• Hydra-Cell employs optional Variable Frequency Drive (VFD) electronic flow control for greater accuracy and repeatability, eliminating lost motion, reducing the chance of operator error, and removing a potential leak path
• Require expensive pulsation dampeners to minimize pulsations	• Multiple-diaphragm design provides virtually pulse-free flow, so expensive pulsation dampeners may not be required
• May only offer PTFE diaphragms, requiring frequent replacement due to stress and poor elastomeric memory	• Available with a wide choice of cost-effective, elastomeric diaphragm materials
• Large footprint to achieve required maximum flow and pressure	• Can meet the same flow and pressure requirements with a much smaller footprint, saving space and costs
• Different plunger and liquid end sizes needed to accommodate changes in operating pressures	• Operates over a wide range of pressures without changes to the plunger or liquid end size
• Integral gearing (necessary to prevent cross-contamination of actuating oil) is difficult and expensive to maintain	• The simplicity of design means lower parts and maintenance costs • Separate gearbox prevents cross-contamination of the actuating oil

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3RD PARTY REFERENCE

Don't just take our word for it:

Impianti OMS (Italy)

This leading machine manufacturer incorporates Hydra-Cell pumps for high pressure additive injection and metering in preference to gear and piston pumps.



Hennecke (Germany)

With more than six decades of experience in the manufacture of PU foam machines, Hennecke uses Hydra-Cell pumps to inject blowing agents into the foam, in preference to much larger and more expensive traditional metering pumps.



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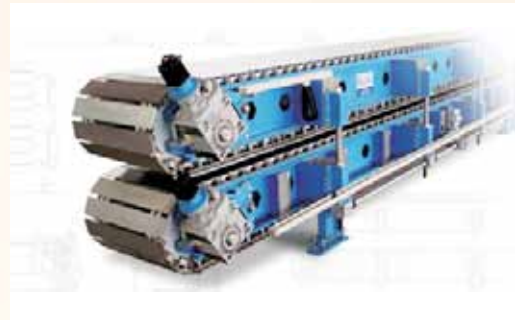
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3RD PARTY REFERENCE

Don't just take our word for it:

PU.MA (Italy)

The world leading designer and manufacturer of sandwich panel production lines uses Hydra-Cell pumps to achieve better than $\pm 1\%$ accuracy when injecting catalysts.



Caligen (Netherlands) VITA Group

This major European manufacturer of PU foams has been successfully using Hydra-Cell pumps to meter and inject Polyols and Isocyanates in its manufacturing process since 1999.



Kingspan (UK and Ireland)

This major manufacturer of PU insulation panels uses Hydra-Cell pumps to meter accurately and inject isocyanates into the system, overcoming potential crystallisation problems.



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APPENDIX



METERING FOR FOAM PRODUCTION

infoBITE

Greater Capability in a More Compact Design

A manufacturer of hard and soft foam was using an expensive triplex diaphragm pump to inject water and a catalyst into the process to mix with Polyol and TDI (an Isocyanate) and produce the polyurethane foam. Metering accuracy is critical because if the amount of water with the catalyst is reduced by just 1%, there will be a dramatic risk of fire.

To maintain accuracy, cumbersome manual or air-driven adjustments were necessary with the triplex diaphragm pump. A compact Hydra-Cell D-10 was installed, saving significant floor space while providing a wider range of flow

capacities and pressure ratings. In addition, Hydra-Cell can handle low-to-high viscosity fluids without any effect on accuracy.

Equipped with a PLC-controlled DC servo motor featuring a tachogenerator, the Hydra-Cell pump meets the requirements for accuracy (as well as linearity and repeatability). It shows all pumping parameters on a screen and maintains a record of the process for enhanced quality control

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Seal-less Pumping Technology



A lower-cost Hydra-Cell D-10 replaced a triplex diaphragm pump to inject water and a catalyst in the production process of polyurethane foam. Hydra-Cell offers a variety of materials of construction and provides virtually pulse-free flow, eliminating the need for expensive dampeners.

www.hydra-cell.eu



POLYURETHANE BLOWING

infoBITE

Blowing PU Foam with Hydra-Cell Pumps

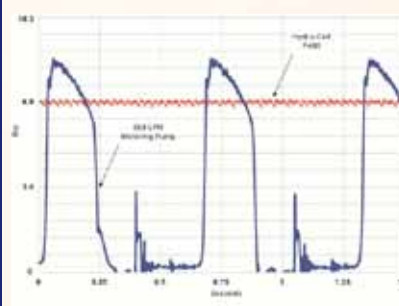
There is a requirement under EU law to change traditional blowing agents such as Freon to an agent with 'zero ozone depletion potential' (ODP). The EU has given a 2 year period to cease using Freon in the process.

This is a commercial opportunity/window to promote Hydra-Cell in these applications.

Hydro fluorocarbons (HFC's) are a proven solution but at less than a quarter of the cost of some HFC grades, Pentanes, (isopentane, n-pentane, and cyclopentane) are gaining in popularity. These low boiling point, non lubricating, flammable hydrocarbons require pumps with ATEX approval and Hydra-Cell is proving the ideal solution... We are currently replacing traditional single diaphragm pumps due to the relatively low pulsation of our triplex design, smaller footprint and cost effectiveness!

Because Pentanes have such low vapour pressures it is imperative that they be kept cool or under pressure in order to be pumped without outgassing. The small size of Hydra-Cell pumps enables them to be refrigerated more economically. The small multi diaphragm liquid chamber also means that the heat transfer to the liquid is dramatically reduced. The Hydra-Cell pumps are also capable of handling high inlet pressures (up to 35 bar) which gives the end user further options to overcome the low vapour pressure of these fluids.

Some of the flexible PU foam grades are expanded with water, water with other additives, catalysts and blowing agents, injected into the polymer mix at pressures from 50 to 170 Bar... Pressures within the capabilities of the current Hydra-Cell range.



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APPENDIX



POLYURETHANE

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Hydra-Cell® Go4 Pumping Polyurethane Foam Catalyst

Both corrosive and toxic, Dimethylcyclohexylamine is a common catalyst used in the production of rigid insulation foam.

A Hydra-Cell® Go4 with the new PTFE diaphragms was placed on Beta site test in this application through Verder Romania.

After 5 weeks the pump was returned for inspection and the diaphragms showed no signs of fatigue, stress or chemical attack. The customer was keen to purchase the pump... it was returned and has been running faultlessly ever since.

Pump code - Go4EDRJ*HFSCG

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TWICE THE LIFE

TECHNO BITE

New PTFE Diaphragms

New PTFE diaphragms are now available for the Go3, Go4, P200 and P300 Hydra-Cell pump models. The newly designed diaphragms offer over twice the working life of the

previous versions (4000+ hours at 1000 rpm) and work under flooded suction conditions with no apparent loss of flow when compared to elastomer diaphragms.

- **Enhanced product range...** For the first time we can now supply Go4/P300/PTFE diaphragm combinations.
- **Long life operation...** Tested to over 240 million cycles. (2600 hrs @1500 rpm, 4000 hrs @1000 rpm 7100 hours @290rpm for P200/P300)
- **No loss of flow...** compared to elastomer diaphragms
- **Flooded suction inlet condition...** Operates without need for 2 bar min inlet pressure.
- **PTFE diaphragm face material is FDA approved for food contact**

Hydra-Cell Go3, Go4, P200 and P300 models can now be recommended for chemical duty metering, dosing and transfer with increased confidence.



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GLOSSARY

Terms Encountered in the
Polyurethane Industry

ADDITIVE: A substance that is added to a resin, usually in relatively small amounts, to alter its properties. Examples are catalysts, fire retardants, stabilisers, pigments and blowing agents.

AIR TRAPS: Voids in moulded polyurethane parts caused by encapsulation of air pockets during the mould filling process. These voids have smooth, shiny surfaces.

AMINE: A class of compounds used as catalysts or curatives in polyurethane foam and elastomer reactions.

ANTI-STATIC POLYURETHANE FOAM: polyurethane foam that contains electrically conductive materials to prevent static electricity build-up or promote static discharge.

BARRIER COATING: Also known as an “in-mould coating”. A coating that is spray applied to the mould surface before pouring of foam or elastomer occurs.

BLOCK FOAM: Low, medium or high density polyurethane foam blocks produced in large reinforced rectangular mould boxes (typically 2.4 x 1.2 x 1.0 metres in size).

BLOWING AGENT: A substance incorporated in a mixture for the purpose of producing foam.

Polyurethane foam can be produced using a physical blowing agent, or a chemical blowing agent.

- Physical blowing agents are gaseous or low boiling point liquids, which form finely dispersed bubbles in the reacting liquid polyurethane. Heat generated by the reacting polyurethane expands the blowing agent bubbles, creating foam.

- Chemical blowing agents are substances added to a polyurethane that undergo a chemical reaction which releases gas bubbles. The most commonly used reaction is that between water and the diisocyanate. This reaction produces carbon dioxide gas bubbles, forming foamed polyurethane.

CASTING: The process of producing a cast by pouring uncured liquid polyurethane into open moulds.

CATALYST: Classically, a substance that accelerates a chemical reaction when added to the reactants in a minor amount, and that is not consumed in the reaction. Today, the term catalysts tends to include substances added to the reacts in minor amounts, that accelerate the reaction but are also consumed in the reaction.

CHAIN EXTENDERS: Low molecular weight molecules which usually react with diisocyanates. They form rigid, crystalline hard segments in the polyurethane and lengthen the main urethane chain by end-to-end attachment.

CLOSED POUR: The process in moulded foam production in which the mould lid is closed and locked and the foaming mixture is introduced through one or more special ports in the lid of the mould.

COLD MOULDING: Moulding process for the production of high-resiliency foam in which the foam is mixed, dispensed and cured at or near room (ambient) temperature.

COMPONENT: In polyurethanes, refers to the liquid Part A Polyol and Part B Isocyanate materials which, when mixed together, react to form a polyurethane.

CREAM TIME: In polyurethane foams, the interval of time between mixing together the polyol and diisocyanate and the first definite appearance of foam expansion.

CROSS-LINKING: Formation of chemical bonds or bridges between separate polymer chains, resulting in a three dimensional polymer network.

GLOSSARY

Terms Encountered in the
Polyurethane Industry

DIISOCYANATE: A chemical compound, usually organic, containing two reactive isocyanate groups. Isocyanate groups are chemical species that react with other chemical species containing “active” hydrogen atoms such as alcohols or amines. Often abbreviated to isocyanate or iso in the polyurethane industry

EXOTHERMIC: A chemical reaction which generates heat and releases the heat to the environment around it.

FILLER: A compound added to a polyurethane to:

- 1) Alter its density without significantly affecting its properties
- 2) Reduce the cost of the polyurethane
- 3) Act as a heat sink and reduce the exotherm generated by the polyurethane
- 4) Enhance specific properties of the polyurethane.

FROTHING: A method of producing polyurethane foam using gaseous blowing agents. Gases such as HCFC 22, HFC 134a, carbon dioxide or nitrogen are introduced into the foam components, under pressure, before or during mixing.

HFC: (Hydrofluorocarbons) are compounds containing carbon, hydrogen and fluorine. They are used as foam blowing agents, aerosol propellants and refrigerants. They contain no reactive chlorine and therefore cause no depletion of the atmospheric ozone layer.

HFO: (Hydrofluoroolefin) are compounds containing carbon, hydrogen and fluorine. They are used as foam blowing agents. They contain no reactive chlorine and therefore cause no depletion of the atmospheric ozone layer. Unlike HFCs & HCFCs, HFOs are not Greenhouse gases and do not contribute to global warming. They are currently the most efficient non-ozone depleting, non-global warming foam blowing agents available.

HOT MOULDING: A flexible moulded foam production process in which high oven temperatures are used to drive the curing reaction in foams made from relatively low-reactivity polyols and TDI.

ISOCYANATE: See Diisocyanate.

ISOCYANURATE: Also known as polyisocyanurate, abbreviated as PIR. A family of rigid polyurethane foams developed specifically as insulation materials having superior flame retardant properties.

MIXING HEAD: The device that mixes two or more component streams before dispensing the mixed polyurethane onto the mould or production surface.

NUCLEATION: In polyurethane foams, the process of introducing small quantities of a finely dispersed gas (or sometimes a solid) into the foam during mixing. The gas bubbles act as sites that encourage foam blowing agents to generate their own micro fine bubbles. The result is a polyurethane foam having a very fine cell structure, which ensures optimal foam physical properties.

OPEN CELL STRUCTURE: The permeable structure in flexible foam in which most of the cell walls in the foam have been ruptured, allowing gases or liquids to readily pass through the foam.

POLYESTER POLYOL: A chemical building block used to produce polyurethane foams, elastomers, coatings and prepolymers. The polyester provides good solvent resistance and good mechanical properties in the final polyurethane. Some polyesters are used to enhance flame retardant properties of polyurethane foams.

POLYETHER: A chemical building block used to produce polyurethane foams, elastomers, coatings and prepolymers. The polyether provides good resilience, hydrolytic stability, mechanical properties and cost advantages.

GLOSSARY

Terms Encountered in the
Polyurethane Industry

POLYISOCYANURATE: Abbreviated as PIR. A family of rigid polyurethane foams developed specifically as insulation materials having superior flame retardant properties.

POLYMER: A natural or synthetic substance made of giant molecules formed by the repeated union of simple molecules (monomers). A copolymer contains more than one type of monomeric unit.

POLYOL: An organic compound having more than one hydroxyl (-OH) group per molecule. The term includes monomeric and polymeric compounds containing hydroxyl groups such as polyethers, glycols, glycerol, and polyesters, used as reactants in polyurethane foam, elastomers, coatings and prepolymers.

POLYURETHANE: Abbreviated as PUR or PU. A large family of polymers with widely ranging properties and uses, all containing urethane linkages, based on the reaction of an organic diisocyanate with compounds containing a hydroxyl group.

PREPOLYMER: A reacted but not completely polymerised chemical intermediate manufactured by reacting polyols with diisocyanates. Generally, the product contains residual, unreacted isocyanate groups, which can be further reacted with polyols, diamine curatives or water to produce the final polymer.

RIM: Abbreviation for Reaction Injection Moulding. The RIM process involves the rapid metering, and mixing of polyurethane reaction ingredients, followed by their injection into a mould. It allows the rapid production of moulded polyurethane components.

RISE TIME: In polyurethane foams, the interval of time between mixing together the polyol and diisocyanate and the point where foam expansion ceases

SLABSTOCK: Rigid or flexible polyurethane foam made in the form of a continuous or discontinuous block, usually of approximately rectangular cross-section.

SYSTEM: The two (or more) polyol and isocyanate components which, when mixed together, react to form a polyurethane or polyisocyanurate polymer.

TDI: An abbreviation for toluene diisocyanate.

TRIOL: A polyol containing three reactive hydroxyl groups.

VAPOUR PRESSURE: The pressure exerted by the vapour above a liquid when the two are in equilibrium. The value depends on the substance and the temperature of the system.

VAPORIZATION: The process of changing from a liquid to a gaseous state.

VISCOSITY: The thickness of a substance and its resistance to flow. The higher the viscosity number, the thicker the substance. The ratio of shearing stress to rate of shear.

VOC: (Volatile Organic Compound) Any compound containing carbon and hydrogen or containing carbon and hydrogen in combination with other elements, which is volatile or readily vapourises.

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EXHIBITIONS

Polyurethane/Plastics Exhibitions

PU China	10 - 12 September 2013	Nanjing International Expo Centre
K Show	16 - 23 October 2013	Dusseldorf Germany
PU Tech Eurasia	14 - 16 November 2013	Istambul Expo Centre
Interplastica	28 - 31 January 2014	Moscow, Russia
Oman Plast	11 - 13 February 2014	Muscat, Oman
Plastivision Arabia	17 - 20 February 2014	Sharjah, United Arab Emirates
PU Tech	9 - 11 March 2014	Noida India
Plastixexpo	27 - 29 March 2014	Parma, Italy
Fakuma	14 - 18 October, 2014	Friedrichshafen, Germany

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Meeting Information Notes

Key decision makers

Supporting decision makers

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Notes on current process liquids, pumps, process parameters etc

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Identify parts of the customers' process where Hydra-Cell can show value.

Item	Cost / Time spent	Further implications	Cost / Time spent