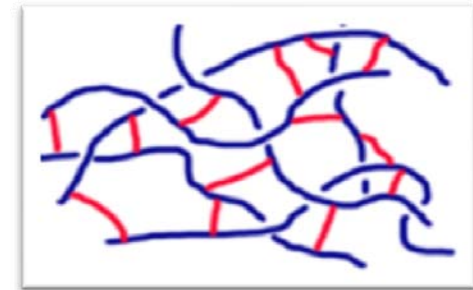


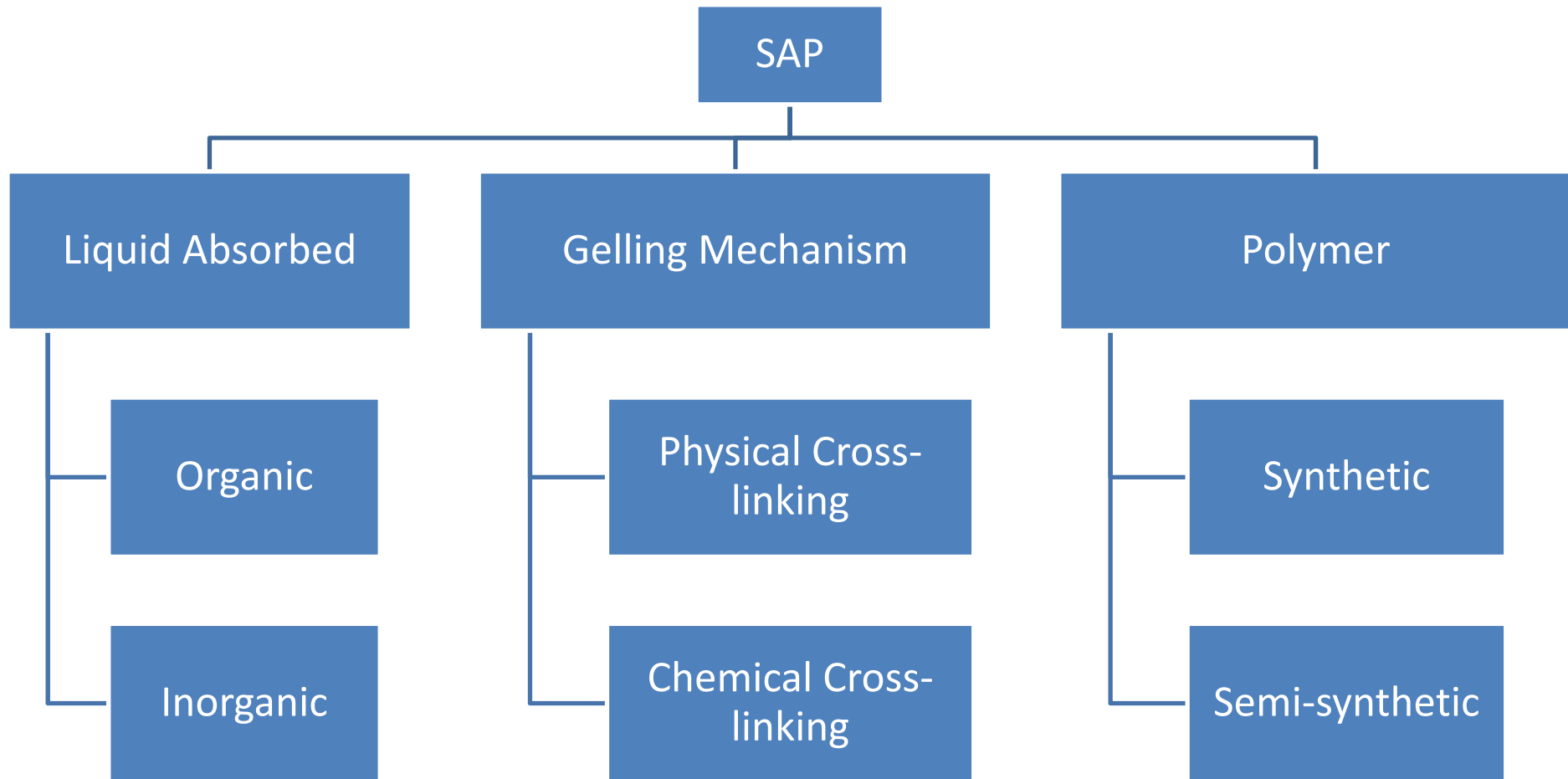
Superabsorbent Polymers

Background for Superabsorbent Polymers

- ▶ **Polymer**
 - ▶ A large molecule composed of several repeating units
- ▶ **Polymer gels**
 - ▶ 3-D network of polymer molecules
 - ▶ Network is achieved by
 - ▶ Chemical crosslinking
 - ▶ Physical crosslinking
- ▶ **Superabsorbent Polymers (SAP)**
 - ▶ Chemically or physically cross linked polymer gels
 - ▶ Capable of absorbing liquids
 - ▶ Total absorbency and capacity of swelling depends on degree of cross linking



Superabsorbent Polymer Classification



Scientist



Dr. M.V. Badiger

Scientist, Polymer Science & Engineering Division

Areas of interest :

- ▶ Chemistry and technology of superabsorbent polymers
- ▶ Water-soluble polymers and hydrophobically modified associating polymers
- ▶ Stimuli-responsive polymers and hydrogels, solid-state NMR of hydrogels

Web: <http://www.ncl-india.org/people/showframe.jsp?personid=79>



Dr. A. K. Lele

Scientist, Polymer Science & Engineering Division

Areas of interest :

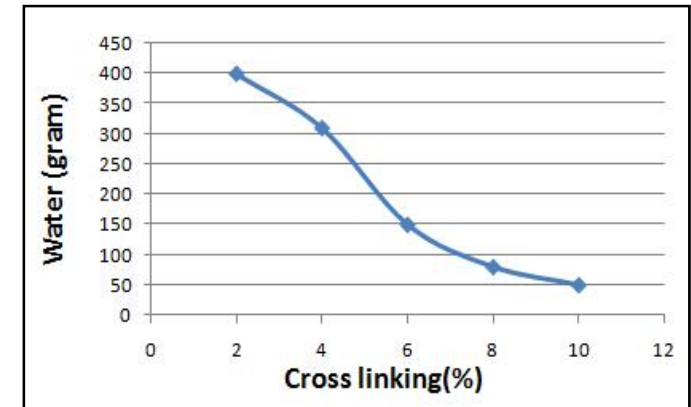
- ▶ Product development activities
- ▶ Micro phase separated systems and food products
- ▶ Engaged in fundamental research on rheology of complex fluids and dynamics

Web: <http://www.ncl-india.org/people/showframe.jsp?personid=32>

NCL Competencies

Water absorbing polymers

- ▶ Synthesis of superabsorbent polymers that can absorb up to 400 grams of water per gram of dry polymer.
- ▶ Control on absorption capacity of SAP by controlling the crosslinking.
- ▶ Materials used: Polyacrylic acid, Polyacrylamide, Poly(*N*-isopropylacrylamide) (PNIPAM), Polysaccharides



Alcohol absorbing polymers

- ▶ Absorbs methanol and ethanol
- ▶ Synthesis of superabsorbent polymers that can absorb up to 350 grams methanol/gm of dry polymer and up to 390 gms of ethanol/gm of dry polymer
- ▶ Materials used: Acrylamido-2-methyl-propane sulfonic acid (AMPS)



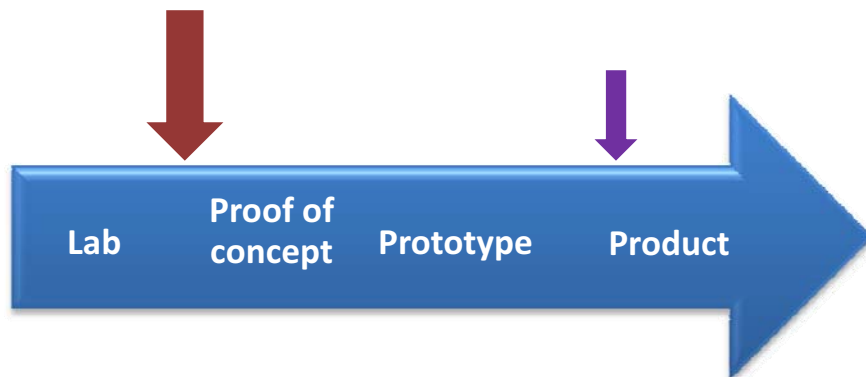
Know How:

Process for making water and alcohol absorbing polymers.

Representative Markets

Healthcare	■
Automotive	□
Construction	■
Agriculture	■
Entertainment	■
Infrastructure	□
Personal care	■
Industrial	■
Water	□

Technology Status



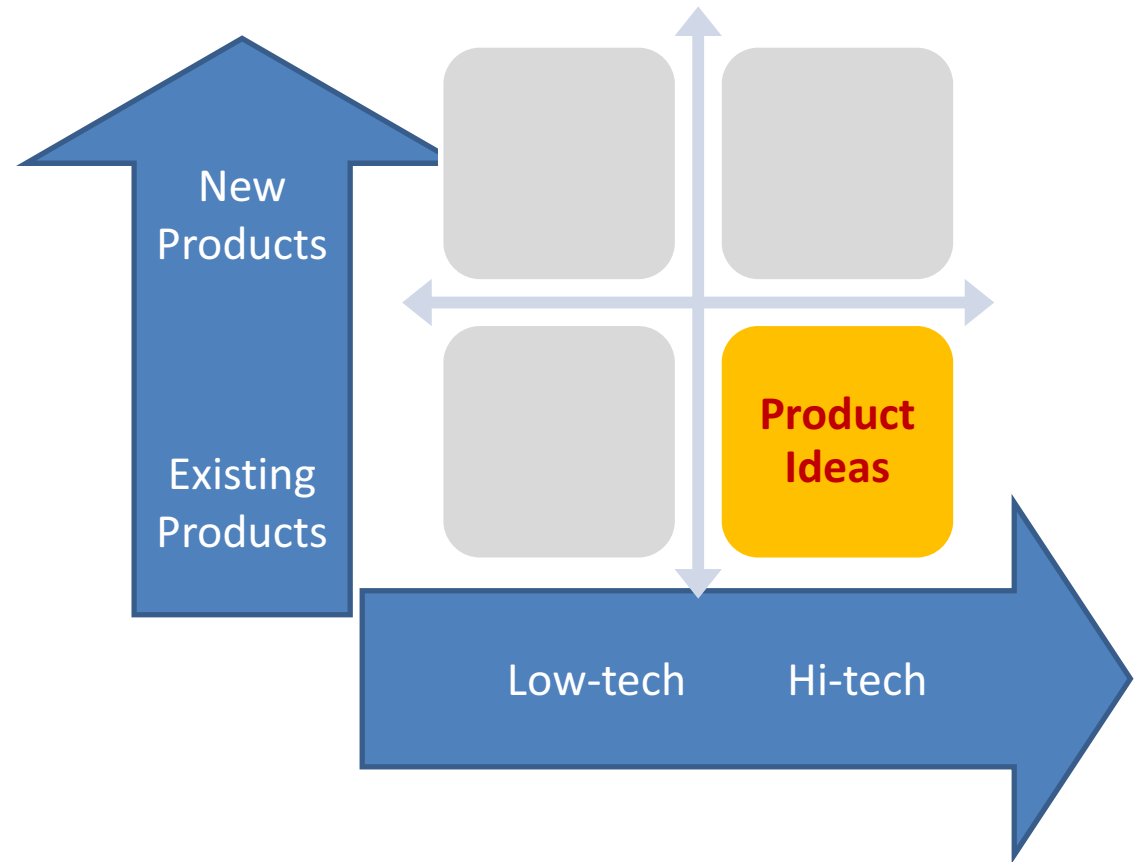
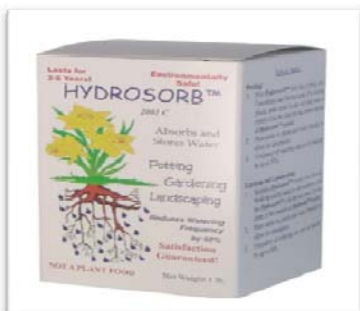
Costs Associated with Technology

Major costs/risks

- **Key raw materials**
- Additional materials
- Cost of manufacturing
- Regulatory cost
- Certification cost & quality control
- Scale of production
- IP costs
- Human resources cost
- Capital expenditure

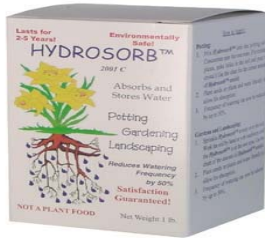
IP Status

Process for the preparation of polymeric absorbents -(2873/DEL/1998, US 6794467)



Superabsorbent Polymers

Superabsorbent Soil Polymers



Use

- ▶ Seed coating, root dipping, soil broadcasting, flower beds, ornamental gardens

Mechanism

- ▶ Absorbs water and makes it available to the roots of the plant

Key Engineering Parameters

- ▶ Amount of water absorbed 300 times
- ▶ Watering frequency less than 50 %
- ▶ Lifespan in soil 5 years
- ▶ Additives reduced by 50%

Price

- ▶ Hydrosorb 2001 C – 0.5 kg. Box-Rs 486
- ▶ Horta-Sorb 0.5 kg Box- Rs 679

Market Segment

- ▶ Agriculture, Horticulture

Repr. Manufacturers

- ▶ Foreign
 - ▶ **Hydrosorb Inc, CA, USA**
 - ▶ M² Polymer Technologies Inc.
 - ▶ Horticultural Alliance, Inc (Horta-Sorb), USA
- ▶ Indian
 - ▶ Amit Biotech (Jal-Dhar)

Source: <http://www.hydrosorb.com/docs/HydrosorbAG.pdf>
<http://www.thehindubusinessline.com/life/2008/09/05/stories/2008090550100400.htm>
<http://www.superabsorbent.com/products.htm>
http://www.m2polymer.com/html/super_absorbent_water_crystals_for_plants.html

<http://www.thehindubusinessline.com/2002/08/12/stories/2002081201461300.htm>
http://www.horticulturalalliance.com/Horta-Sorb_General_Discussion_On_Superabsorbents_and_Their_Properties.asp

Absorbent Pads



Use

- ▶ Tamper proof aid for meat packaging, bottles etc

Mechanism

- ▶ Protects meat from moisture, temperature, contamination by absorbing any unsightly excess liquids

Key Engineering Parameters

- ▶ Amount of water absorbed 800 ml/m²
- ▶ Weight of paper 78 grammage/m²

Price

- ▶ DriLoc pads (4*7 pads)-
Rs 1383/2000pc

Market Segment

- ▶ Packaging industry

Repr. Manufacturers

- ▶ Foreign
 - ▶ **Sealed Air corporation, USA**
 - ▶ Sirane, UK
 - ▶ Elliott Absorbent Products Limited

Source: <http://www.sealedair.com/products/food/pads/driloc.html>
<http://www.teal-sorb.com/products.html>
<http://www.stylefeeder.com/i/tt9x9ld3/Park-Seed-Aqua-Pad-Water-Absorbing-Mats-Pack-Of-5>
<http://www.sirane.co.uk/>

<http://www.elliottabsorbents.co.uk/pages/bulksorb.php>
<http://www.thefind.com/pets/info-dri-loc-meat-pad>

Cooling Wear



Use

- ▶ Ties, head bands, vests, caps

Mechanism

- ▶ Targeted cooling for key heat zones (neck, head, wrist)

Key Engineering Parameters

- ▶ Amount of water absorbed
400 times the weight

Price

- ▶ M² Polymer Technologies Inc
Rs 2146/kg SAP
- ▶ TechNiche – Rs 200/pc
- ▶ Watersorb – Rs 940/kg SAP

Market Segment

- ▶ Textiles
- ▶ Travel accessories

Repr. Manufacturers

- ▶ Foreign
 - ▶ **Watersorb**, a subsidiary of
Polymers inc.
 - ▶ TechNiche
 - ▶ M² Polymer Technologies Inc

Source:

http://www.m2polymer.com/html/cool_ties_water_crystals.html <http://www.thehindubusinessline.com/life/2008/09/05/stories/2008090550100400.htm>
http://www.watersorb.com/polymer_cool_neck_bands.htm <http://www.polarsoftice.com/bodycoolingevap.html>



Use

- ▶ Movies, snow parties, ski resorts, indoor ski slopes etc

Mechanism

- ▶ Dry powder expands in volume upon absorbing water and resembles snow

Key Engineering Parameters

- ▶ 10gms of dry snow powder expands to 60 times its volume

Price

- ▶ M² Polymer Technologies Inc
Rs 966/ 450gms SAP
- ▶ Snow Business Rs 248/10gms
- ▶ Insta-snow Rs 516/100gms

Market Segment

- ▶ Entertainment industry

Repr. Manufacturers

- ▶ Foreign
 - ▶ **Snow business**
 - ▶ M² Polymer Technologies Inc

Superabsorbing Baby Diapers



Use

- ▶ Baby diapers, nappy pads

Mechanism

- ▶ Layered construction which allows the transfer and distribution of urine to an absorbent core structure where it is locked in.

Key Engineering Parameters

- ▶ Amount of absorption 100ml/gm
- ▶ Qty of SAP 4gms/diaper

Price

- ▶ Diapers cost around Rs 7-14 each.
- ▶ Rs 11/pc - Pampers (P&G)
- ▶ Rs 14/pc – Huggies
- ▶ Rs 6.5/pc - J&J (nappy pads)

Market Segment

- ▶ Disposable baby diaper mkt-Rs 200cr

Repr. Manufacturers

- ▶ Foreign
 - ▶ P&G (Pampers)
 - ▶ **Kimberly –Clark** (Huggies)
- ▶ Indian
 - ▶ Wipro baby soft cloth-feel diapers
 - ▶ Godrej- snuggy diapers
 - ▶ Cuddles India, New Delhi

Source: <http://dir.indiamart.com/impcat/baby-diapers.html>
<http://www.thehindubusinessline.com/life/2008/09/05/stories/2008090550100400.htm>
<http://www.thehindubusinessline.com/catalyst/2003/12/11/stories/2003121100020300.htm>

<http://economictimes.indiatimes.com/News/News-By-Industry/Cons-Products/FMCG/Godrej-SCA-is-now-a-100-GCPL-arm-after-stake-buyout/articleshow/3820815.cms>



Use

- ▶ Adult incontinence products (urine, fecal)

Mechanism

- ▶ Layered construction which allows the transfer and distribution of urine to an absorbent core structure where it is locked in.

Key Engineering Parameters

- ▶ Amount of absorption: 70-170gms

Price

- ▶ Healthdri- Rs 198/pc
- ▶ Tena- Rs 33/pc
- ▶ Abri-form – Rs 49/pc

Market Segment

- ▶ Personal hygiene products

Repr. Manufacturers

- ▶ Foreign
 - ▶ **The Salk company** (HealthDri)
 - ▶ Svenska Cellulosa Aktiebolaget, Sweden (Tena)
- ▶ Indian
 - ▶ Hicks (Abri-form)

Feminine Sanitary Napkins



Use

- ▶ Sanitary napkins

Mechanism

- ▶ Layered construction allowing the transfer & distribution of menses to an absorbent core structure where it is locked in.

Key Engineering Parameters

- ▶ Cotton dry cover with one-way holes that trap fluid inside
- ▶ Anti leak core to lock in fluid
- ▶ Odour neutralizer, Should not irritate skin

Price

- ▶ Stay free- Rs 7/pc
- ▶ Whisper- Rs 8/pc

Market Segment

- ▶ Personal hygiene products

Repr. Manufacturers

- ▶ Foreign
 - ▶ Whisper
 - ▶ **Stayfree**
 - ▶ Kotex (Kimberly-Clark)
 - ▶ She



Use

- ▶ Primary dressing for dermal wounds like pressure ulcers, skin tears, burns etc

Mechanism

- ▶ Maintains a moist environment enhancing healing & prevents wound desiccation promoting autolytic debridement of a dry wound

Key Engineering Parameters

- ▶ No preservatives, Latex- free

Price

- ▶ 3M Tega derm- Rs 240/15gm
- ▶ WounDres- Rs 1554/80 gm
- ▶ Curasol Rs 1166/80 gm

Market Segment

- ▶ Healthcare

Repr. Manufacturers

- ▶ Foreign
 - ▶ **3M™ Tegaderm™ Hydrogel Wound Filler**
 - ▶ Coloplast Corporation (WounDres® Collagen Hydrogel)
 - ▶ Health point Ltd (Curasol gel wound dressing)

Sand Bags for Flood Control



Use

- ▶ Temporary protection against flooding

Mechanism

- ▶ The SAP present in the sand bags absorbs the water making the bag swell, preventing water from entering into the premises.

Key Engineering Parameters

- ▶ Automatically inflates in only 3-5 minutes
- ▶ Expands from 0.50kg to up to 25kg
- ▶ Shelf life of 5 -10 years
- ▶ Bag is biodegradable

Price

- ▶ Aqua-Sac- Rs 453/pc

Market Segment

- ▶ Flood protection
- ▶ Factory protection
- ▶ Underground parking protection
- ▶ Water line construction on roads, highways
- ▶ River banks

Repr. Manufacturers

- ▶ Foreign
 - ▶ World wide tech solutions
 - ▶ **Aqua-Sac**

Disposable Urinal



Use

- ▶ Unisex emergency urinary bag

Mechanism

- ▶ The SAP absorbs and solidifies the urine.

Key Engineering Parameters

- ▶ Volume(Max): 800 cc
- ▶ Weight: ~42 gm before use

Price

- ▶ TravelJohn™ Disposable Urinal- Rs 50/pc

Market Segment

- ▶ Travel accessories

Repr. Manufacturers

- ▶ Foreign
 - ▶ Travel John



Use

- ▶ To solidify medical waste in suction canisters.

Mechanism

- ▶ Dry powder absorbs and retains the liquid waste when poured into suction canister

Key Engineering Parameters

- ▶ Rate of absorption: 3000 cc in 4 min
- ▶ Degree of absorption 25 grams/ lit.

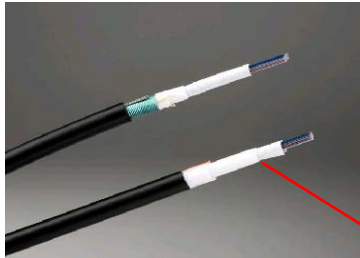
Price

Market Segment

- ▶ Hospitals
- ▶ Nursing homes
- ▶ Clinics

Repr. Manufacturers

- ▶ Foreign
 - ▶ ZappaTec LLC
- ▶ Indian
 - ▶ Novogene life sciences pvt. Ltd.



Water swellable polymer tape

Use

- ▶ To provide protection against damage and corrosive effect of water

Mechanism

- ▶ Tape consisting of SAP is wrapped around the cable to prevent water penetration

Key Engineering Parameters

- ▶ Swelling speed: 3 mm/ minute
- ▶ Swelling height: 6 mm after 3 minutes
- ▶ Mass per unit area: 75 ± 10 gram/m²

Price

Market Segment

- ▶ Power, fiber and copper telecom cable

Repr. Manufacturers

- ▶ Foreign
 - ▶ Scapa cable solutions, UK
 - ▶ **NEPTCO**
- ▶ Indian
 - ▶ S V Industries, Mumbai
 - ▶ Miracle non-woven products



Use

- ▶ To maintain the dry atmosphere in operation theatres.

Mechanism

- ▶ Polymeric textile consisting sheath of cellulose and SAP absorbs and retains the liquids coming in contact.

Key Engineering Parameters

- ▶ Weight: 100 gram approx.
- ▶ Absorbency: 8 litres of water or 3.5 litre of 0.9% saline solution.

Price

Market Segment

- ▶ Medical textile

Repr. Manufacturers

- ▶ Foreign
 - ▶ Absorbest waterful solutions

Superabsorbent Material Based Dressings for Wounds

SAP

Use

- ▶ Suitable as dressing for pressure ulcers, venous leg ulcers, postoperative wounds

Mechanism

- ▶ A superabsorbent polymer based core absorbs extrudes from wound for longer time at higher rate

Key Engineering Parameters

- ▶ Degree of absorption :120 g/NaCl per 100 cm² of absorbent core

High absorption volume,
for heavily exuding wounds

- 
- flat edges
conforms well to healthy skin and facilitates application
 - non-adherent wound contact layer
prevents adhesion to the wound
 - distribution layer
absorbed exudate is evenly distributed and quickly conducted into absorbent core
 - absorbent core with super-absorbent polymer
absorbs large quantities of wound exudate, forming a gel that binds and locks the exudate away from the wound
 - blue strike-through protective outer layer
protects clothing and bed sheets against soiling

Price

- ▶ Xtrasorb: Rs. 82/piece

Market Segment

- ▶ Wound dressing

Repr. Manufacturers

- ▶ Foreign
 - ▶ Derma Sciences, Inc.



Use

- ▶ To prevent bleeding of water-based paint into the masking tape.

Mechanism

- ▶ Sides of the masking tape are coated with a layer of SAP which forms a barrier between masked and unmasked area

Key Engineering Parameters

Price

- ▶ Frog tape: ~ 210 – 270 Rs/m²

Market Segment

- ▶ Interior & exterior wall painting
- ▶ Automotive painting
- ▶ Aircraft, marine painting
- ▶ Fabricated part painting

Repr. Manufacturers

- ▶ Foreign
 - ▶ Shurtape Technologies, LLC
 - ▶ 3M



Use

- ▶ Fire extinguishing and prevention

Mechanism

- ▶ Layer of gel adheres the surface
- ▶ Fire can not spread rapidly since it has to overcome the quantity of water present in the gel

Key Engineering Parameters

- ▶ Particle swell time: < 3 seconds
- ▶ Viscosity of gel: ~ 500 to 50000 cP

Price

- ▶ Barricade gel: ~ Rs. 820 / lit (SAP + oil + surfactants)

Market Segment

- ▶ Fire protection and prevention

Repr. Manufacturers

- ▶ Foreign
 - ▶ Barricade International, Inc.



Use

- ▶ Warming dish at eateries
- ▶ Fuel for fireplaces

Mechanism

- ▶ SAP absorbs and retains the alcohol within it

Key Engineering Parameters

- ▶ Amount of alcohol absorbed: 350-400 gm/gm of dry polymer
- ▶ Rate of burning: 80 g/ hour

Price

- ▶ Rs 25/kg – Sai Laxmi Chemicals, Dombivali
- ▶ Rs 32/kg – Sri Vaishnavi Enterprises, Hyderabad
- ▶ Rs 300/kg – Sterno, UK

Market Segments

- ▶ Hotels, caterers

Repr. Manufacturers

- ▶ Indian
 - ▶ Sai Laxmi Chemical- Dombivli, Maharashtra
 - ▶ Sunflame dish warmer fuel- Hyderabad
 - ▶ **Sri Vaishnavi Enterprises- Hyderabad**