Duke | PRATT SCHOOL of ENGINEERING

SPIDERBOND®
蜘蛛邦®

GREEN ADHESIVES FOR AUTOMOTIVE APPLICATIONS

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SPIDERBOND: THE LEADING HOT MELT POLYAMIDE ADHESIVE SOLUTION

What is Spiderbond's Polyamide Adhesive?

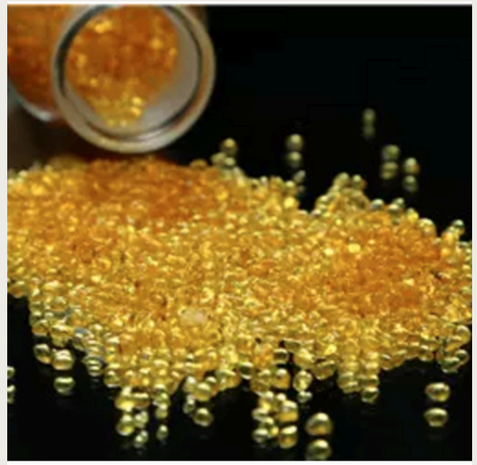
- High-Performance Bonding
- Versatile Applications
- Environmentally Friendly

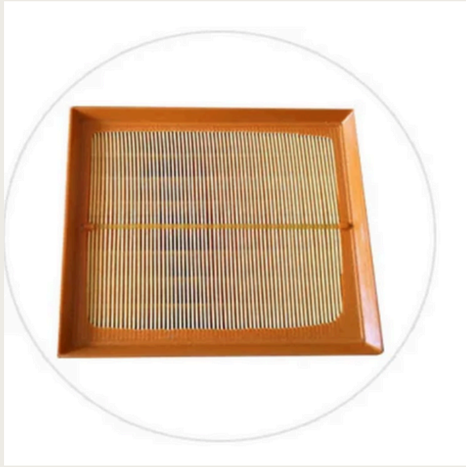
SPIDERBOND®
蜘蛛邦®

Top Polyamide hot melt adhesive manufacturer in Asia

What does Spiderbond Offer?

- Superior Adhesion
- Tailored Solutions
- Convenient Handling
- Sustainability





LIMITED LIFE CYCLE ANALYSIS

Powered by Sustainable Minds® Transparency Products

SPIDERBOND®
蜘蛛邦®

Base Case

- **Configuration:** Synthetic polymers designed for use in oil filter assembly.
- **Advantages:** Exceptional heat resistance, durability, and recyclability .
- **Limitations:** Moderate carbon emissions and energy-intensive production processes.

Comparative #1

- **Configuration:** Adhesives extracted from renewable pine tree sources.
- **Advantages:** Environmentally friendly with low curing temperatures.
- **Limitations:** Moderate carbon emissions during processing and limited recyclability.

Comparative #2

- **Configuration:** Composed of polyols and diisocyanates.
- **Advantages:** High heat resistance, excellent durability, and substrate compatibility.
- **Limitations:** High carbon emissions and limited biodegradability.

*Total amount of service delivered during the lifetime of the product - 5 years

BASE CASE ANALYSIS

Polyamide Adhesives

Adhesive

Component	Material	Weight (lbs)
Adhesive Base	Nylon 6	20.0
Additives	Soybean Oil	5.0
Packaging	Metal Canisters	1.2

Manufacturing

Component	Material	Weight (lbs)
Mixing Equipment	Carbon Steel	60
Heating Element	Nickel Alloy	20
Mold Assembly	Stainless Steel	12

MANUFACTURING AND USAGE

Material Use

Amines	Soybean oil	**5 lb**
Solvent	Ethyl acetate	**5 lb**
Material	Nylon 6	**20 lb**

Water Use

80 gal

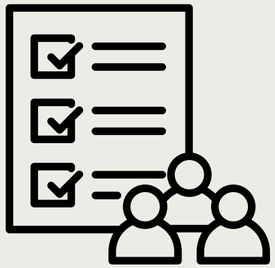
Power Use

2.93 kWh

END OF LIFE AND TRANSPORATATION

1 End of life

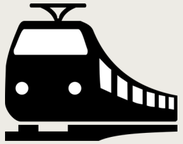
All the materials are subjected to recycling



Ecological impact

0 mpts
0 CO2 eq. kg

2 Transportation



Train - 300 miles → **0.152 mpts**
1.56 CO2 eq. kg

Nationwide Delivery:

The product is transported to various locations across the U.S, tailored to meet client needs.

*mPts - Annual Share of the Environmental Load of an individual

COMPARATIVE CASE -1 ANALYSIS

Pine Tree Fatty Acid Adhesives

Adhesive

Component	Material	Weight (lbs)
Adhesive Base	Pine Resin	40.0
Additives	Pitch Pine	10.0
Process	Wood Chopping	10.0

Manufacturing

Component	Material	Weight (lbs)
Mixing Equipment	Stainless Steel	50
Heating Element	Aluminum	12
Mold Assembly	Carbon Steel	8

COMPARATIVE CASE -2 ANALYSIS

Polyurethane Adhesives

Adhesive

Component	Material	Weight (lbs)
Adhesive Base	Polyurethane	10.0
Precursor	Polyols	44.0
Packaging	Plastic	0.6

Manufacturing

Component	Material	Weight (lbs)
Mixing Equipment	Stainless Steel	55
Heating Element	Copper	15
Mold Assembly	Plastic	10

SUSTAINABLE MINDS LIMITED LCA ANALYSIS RESULT

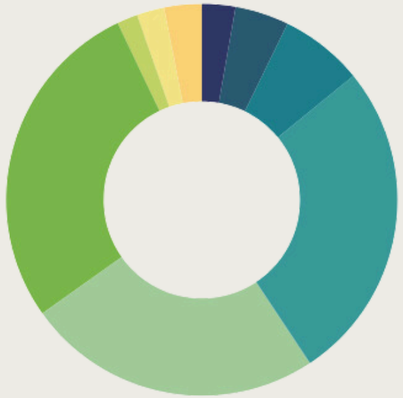
	Base Case: Polyamide Adhesives	Comaparative Case-1 : Fatty Acids	Comparative Case-2 : Polyurethane
Impact/ functional unit*	1.5	1.7	2.4
Greatest Impacts	Nylon 6 Carcinogenics Manufacturing	Electricity 240 V US Carcinogenics	Polyols Carcinogenics Manufacturing
CO2 eq. kg	29	32	31
Comparison		8.8 performance reduction**	55% performance reduction**

*mPts - Annual Share of the Environmental Load of an individual
**performance compared to the Base Case

SUSTAINABLE MINDS LIMITED LCA ANALYSIS RESULT

Environmental impact by category

Polyamide Adhesives (Base Case)

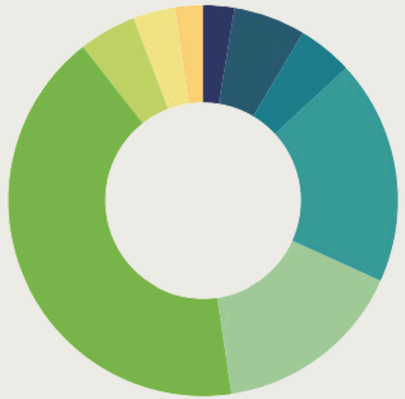


Impact category	%
Ecological damage	
Acidification	2.86
Ecotoxicity	4.61
Eutrophication	7.12
Global warming	27.51
Ozone depletion	0.03
Resource depletion	
Fossil fuel depletion	25.34
Human health damage	
Carcinogenics	28.73
Non carcinogenics	-1.77
Respiratory effects	2.36
Smog	3.21

Fatty acids from Pine trees (Comparative Case-1

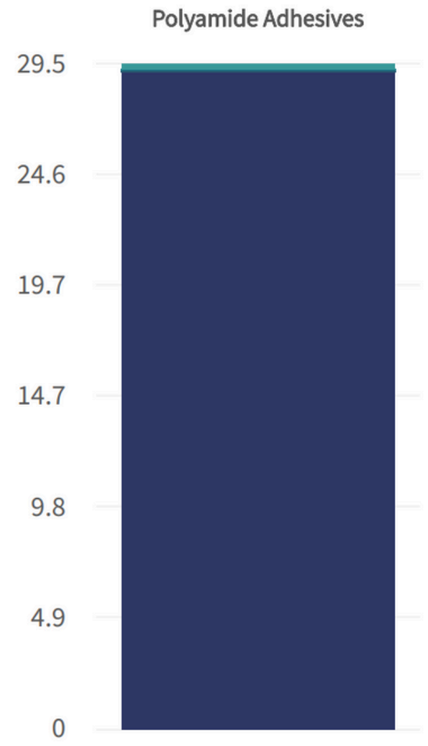
Impact category	%
Ecological damage	
Acidification	4.5
Ecotoxicity	5.13
Eutrophication	4.61
Global warming	27.11
Ozone depletion	0.02
Resource depletion	
Fossil fuel depletion	12.39
Human health damage	
Carcinogenics	29.11
Non carcinogenics	8.02
Respiratory effects	4.78
Smog	4.33

Polyurethane adhesives (Comparative case-2



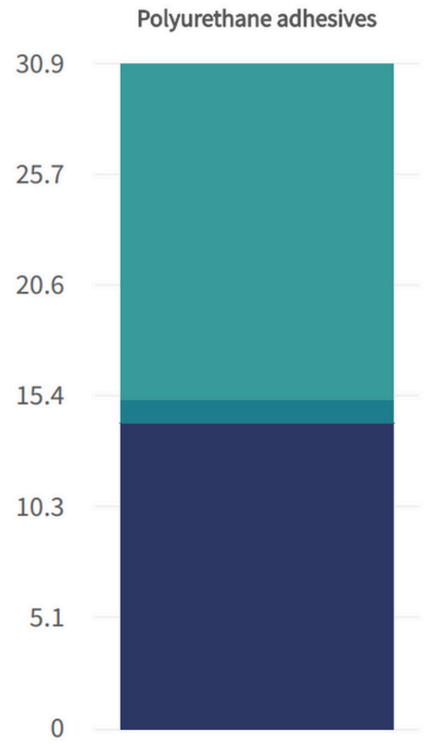
Impact category	%
Ecological damage	
Acidification	2.59
Ecotoxicity	5.98
Eutrophication	4.57
Global warming	18.62
Ozone depletion	0.01
Resource depletion	
Fossil fuel depletion	15.9
Human health damage	
Carcinogenics	41.76
Non carcinogenics	4.76
Respiratory effects	3.49
Smog	2.33

SUSTAINABLE MINDS LCA ANALYSIS RESULT: CARBON FOOTPRINT



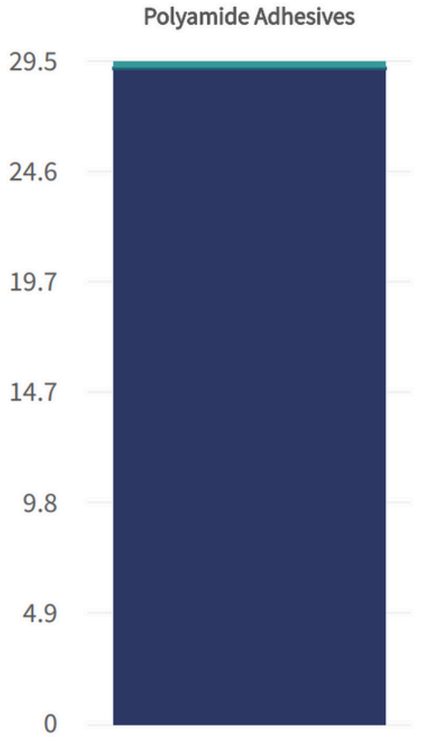
Total = 29 CO2 eq. kg/func unit

Lifecycle stage	CO2 eq. kg/func unit
Manufacturing	29.2
End of life	0
Transportation	0.0857
Use	0.230



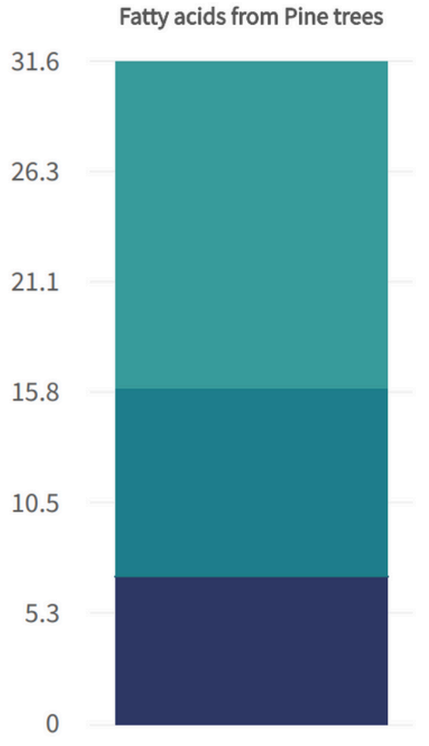
Total = 31 CO2 eq. kg/func unit

Lifecycle stage	CO2 eq. kg/func unit
Manufacturing	14.2
End of life	0.0221
Transportation	1.10
Use	15.6



Total = 29 CO2 eq. kg/func unit

Lifecycle stage	CO2 eq. kg/func unit
Manufacturing	29.2
End of life	0
Transportation	0.0857
Use	0.230



Total = 32 CO2 eq. kg/func unit

Lifecycle stage	CO2 eq. kg/func unit
Manufacturing	7.07
End of life	0
Transportation	9.03
Use	15.5

Cost Analysis - Base Case

No.	Description	Cost per lb
1	Raw Material (Soybean Oil)	$0.0
2	Polymerization	$0.9
3	Cooling and Flaking	$0.2
4	Extrusion and Pelletizing	$0.4
5	Quality Control	$0.09
6	Packaging and Storage	$0.6
7	Transporatation	$0.5

Total production cost for Polyamide adhesives = $2.69 /lb

Cost of Comparative Case #1 = $2.90/lb

Amount in Savings = $0.21/lb
Savings in Percentage = 7%

Cost of Comparative Case #2 = $5.15/lb

Amount in Savings = $2.46/lb
Savings in Percentage = 84%

Cost Analysis - Comparative Case #1

No.	Descritpion	Price (per lb)
1	Raw Material (Pine Resin)	$0.50
2	Processing (Polymerization & Distillation)	$1.00
3	Energy Costs	$0.50
4	Packaging	$0.50
5	Transportation	$0.40

Total production cost for Epoxy adhesives from Fatty acids from Pine Tree = $2.90 /lb

Total Capital Investment in Machines

Machine	Cost Estimate
Polymerization Reactor	**$20,000 - $50,000**
Distillation Units	**$5,000 - $20,000**

Cost Analysis - Comparative Case #2

No.	Descritpion	Price (per lb)
1	Raw Material (Polyols)	$1.5
2	Prepolymer synthesis	$2.00
3	Mixing and Blending	$0.50
4	Curing & Packaging	$0.75
5	Transportation	$0.40

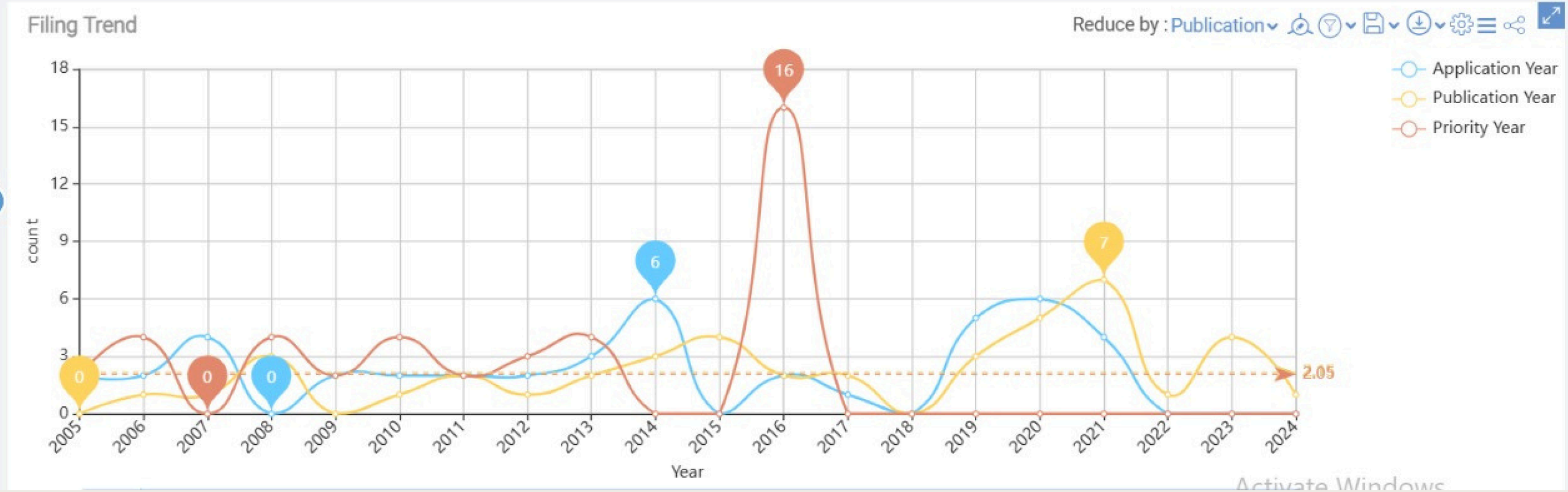
Total production cost for Polyurethane adhesives = $5.15 /lb

Total Capital Investment in Machines

Machine Name	Cost estimates
Reactor (Polyurethane)	$20,000 - $50,000
Curing Oven	$30,000 - $60,000
Mixers (for raw materials)	$10,000 - $20,000
Dispensing Equipment	$5,000 - $15,000

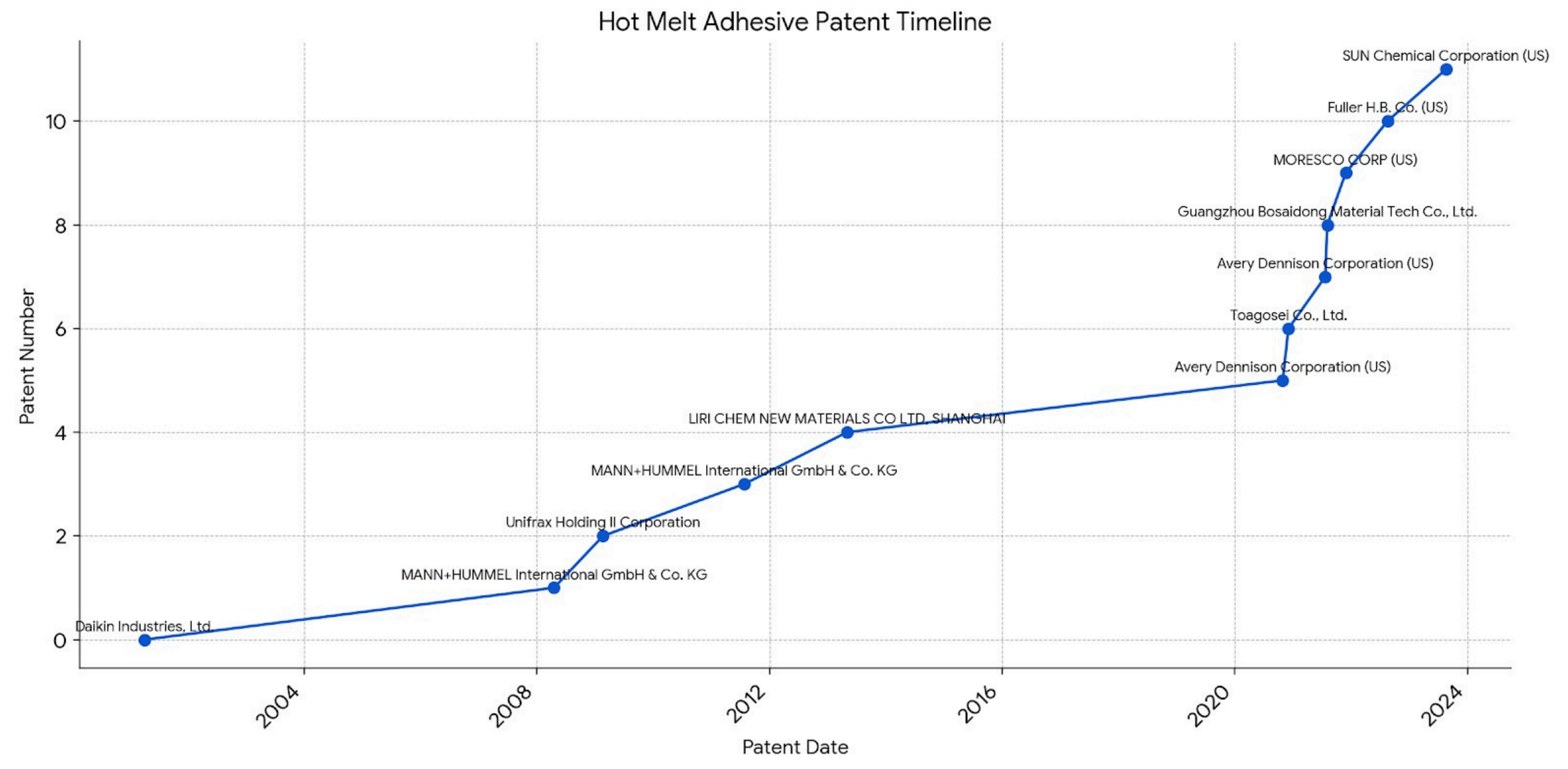
IP AND MARKET VALUATION

Filling trend for competing patents in the industry



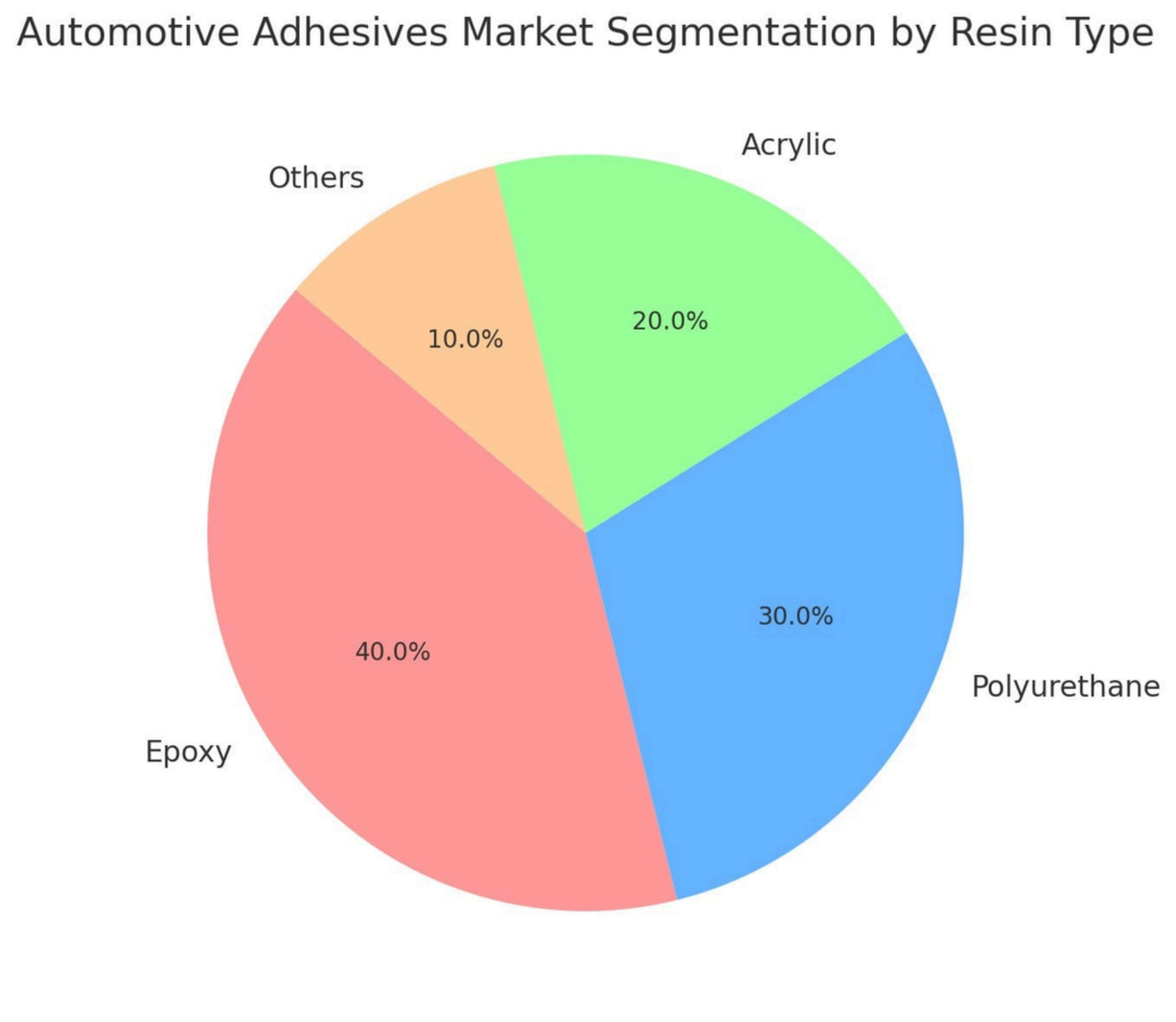
IP AND MARKET VALUATION

Trends in Hot Melt Adhesive Patents (2004–2024): Key Companies and Milestones



IP AND MARKET VALUATION

Automotive Adhesives market segmentation by Resin Type



Epoxy adhesives have high strength and heat resistance and are used in chassis and EV battery assembly.

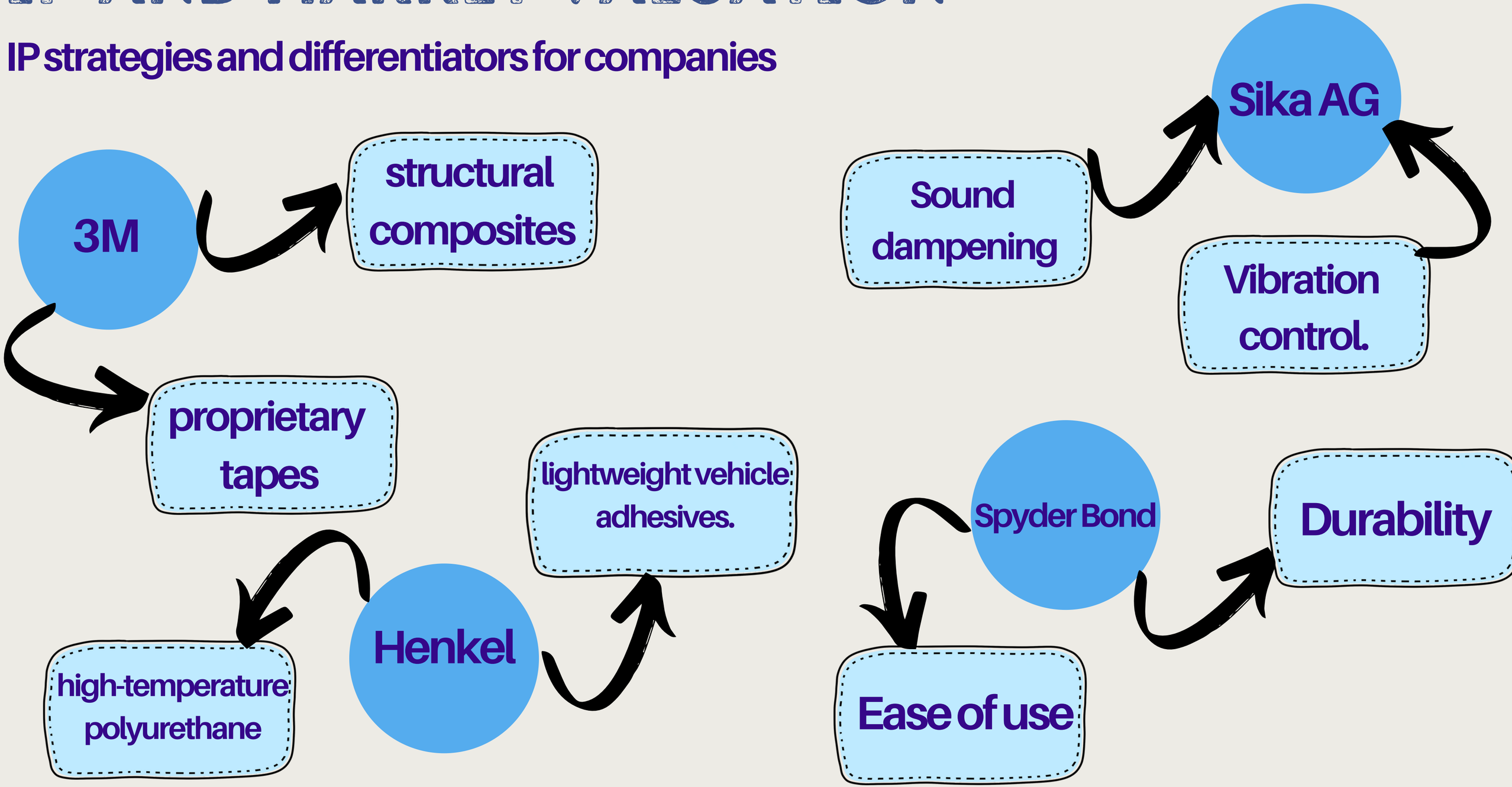
Polyurethane Adhesives: Flexible with strong bonding; key for glass and paneling.

Acrylic Adhesives: Quick setting; used in body structures.

Silicone Adhesives: Temperature resistance; suited for electronics and sensors.

IP AND MARKET VALUATION

IP strategies and differentiators for companies



THANK YOU