CAN POST CONSUMER NYLON CARPET BE RECOVERED INTO CARPET FIBER?

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Where do we start?

- Wide range of feedstock.
- Many recovery models.
- Separation is a science.
How are Nylon fibers made?
How big is small?

- Denier is the number of grams in 9000 meters.
- An “average” carpet fiber is 20 denier/filament.
What is “trilobal”? 

- For a 1.8 modification ratio [MR] trilobal, the outside diameter is about 58 microns.
- 1 micron = 1 x 10^{-6} meters.
What’s “in” and “on” PC Carpet?

- Topical treatments
- Cleaning chemicals
- Dirt
- Microbials
### How is Nylon-66 different from Nylon-6?

<table>
<thead>
<tr>
<th>Nylon-66</th>
<th>Nylon-6</th>
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<td>- Made from hexamethylene diamine and adipic acid</td>
<td>- Made from caprolactam</td>
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<td>- When hot, it will degrade in the presence of oxygen.</td>
<td>- When hot or in a melt, it is more resistant to degradation, gel formation, or chain breakage by moisture.</td>
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<td>- In a melt, it will cross-link to form gels.</td>
<td>- In a fiber, it has less hydrogen bonding than Nylon-66.</td>
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<td>- In a melt, moisture will break polymer chains.</td>
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Are we asking the impossible?

No, but the challenges are formidable:

- Logistics
- Economics
- Purity
What are the alternatives?

- De-polymerization
- Dissolution
- Re-melt / decontamination
Depolymerization

**Advantages:**
• End product is fully suitable for fiber spinning and dyeing.

**Challenges:**
• Capital investment + operation costs
• Nylon-6 “easier” than Nylon-66.
• Centralized
• Separation of non-nylon carpet constituents into commercially useable streams.
## Dissolution

### Advantages:
- End product is fully suitable for fiber spinning and dyeing.

### Challenges:
- Capital investment + operation costs
- Centralized
- Separation of non-nylon carpet constituents into commercially useful streams
**Re-melt / decontamination**

**Advantages:**
- Lower capital investment + operating costs.
- De-centralized
- Pre-consumer materials have been processed successfully for decades.

**Challenges:**
- Separation of face “fluff” from non-nylon components.
- Contaminants are intimately blended with nylon fibers.
- Color remains a variable part of the final pellet.
- Thermal degradation.
- Cash neutral or positive uses for separated non-nylon components.
Important Points

1. The amount of fiber used in new U.S. carpet makes it a very attractive goal for post consumer recovered feedstock.

2. Quality of component separation is important.

3. Fiber spinning needs almost complete contaminant removal – impurities of any size are disruptive.

4. Carpets attract contaminants due to their construction and service location.
Summary

• Ongoing industry efforts validate the concept of PC content carpet fibers.

• Necessity, invention and commitment will drive progress.