Upcycling Agricultural By-Products into Compostable Menstrual Pads
Final Report

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Executive Summary

Aruna Revolution evaluated a Nova Scotian pathway to upcycle agricultural by-products into high-performance, compostable menstrual pads that can return to managed organics at end-of-life. With support from Divert NS, the project mapped the chain from feedstock characteristics and storage, through fiber preparation and prototyping, to third-party testing for compostability and material safety.

Objectives

- Establish supply chain and storage parameters for local agricultural by-products.
- Produce and lab-test prototype materials for nonwovens and absorbent cores.
- Complete independent material characterization and compostability testing aligned with industrial composting in Nova Scotia.
- Document risks, lessons learned, and a clear path to municipal acceptance and certification.

What we did

- Collected and prepared pilot quantities of agricultural by-products and completed bulk property and composition testing, including moisture, volatile solids, CHN/ash, heavy metals, and fluorine.
- Prototyped and evaluated pad materials and cores at bench scale, documenting methods, process windows, and QC gates for the next round of trials.
- Completed third-party material characterization and an industrial-composting biodegradation run on the pad article (tested item excluded the outer wrapper and release paper).
- Advanced the evidence base needed for acceptance by industrial composters in Nova Scotia and for certification pathways.

Key results

- **Industrial composting biodegradation:** The Aruna Regular Pad reached **92.5% biodegradation by day 45 at 58 °C**, meeting the 90% criterion for industrial compostability.
- **Material safety screen:** All measured **heavy metals and fluorine were below prescribed limits** referenced by EN 13432, ASTM D6400, and CAN/BNQ 0017-088.

- **Biobased content:** Independent biobased evaluation completed to support labeling and claims.

Why this matters for Nova Scotia
This project demonstrates that agricultural by-products can be upgraded into a higher-value input for disposable hygiene and then responsibly routed to industrial composting at end-of-life. The approach supports Nova Scotia's circular-economy goals, reduces landfill-bound plastics, and creates a pathway to local manufacturing partnerships and rural economic activity.

Lessons learned

- Feedstock variability can be managed with clear moisture and storage targets and simple blending rules.
- Early definition of QC gates for fiber preparation and core formation reduces trial-and-error in downstream nonwoven and core testing.
- Evidence aligned to local composting conditions is essential for municipal acceptance.

Recommendations and next steps

1. Complete ecotoxicity, and package the full compostability evidence set for certification.
2. Engage one or more Nova Scotia industrial composters for acceptance testing using the current data package, with a clear plan for labeling and routing.
3. Proceed to scaled nonwoven and core trials with defined process windows and QC metrics, informed by the pilot work.

We acknowledge the generous support of Divert NS, without which this research would not have be able to be completed.

Background Information

Disposable hygiene is a growing waste stream. Most pads on the market combine plastics, superabsorbent polymers, adhesives, and bleached pulp. These multi-material products are difficult to recycle, they do not break down in landfills, and they are not accepted in organics programs. As a result, the default pathway is landfill, with costs borne by municipalities and long-lived plastic fragments persisting in the environment.

At the same time, the market is crowded with products that use words like “eco,” “biodegradable,” or “compostable” without clear evidence or without specifying where and how they actually break down. That kind of greenwashing confuses residents and compost facility operators, creates contamination risk in the organics stream, and erodes trust in legitimate solutions. Clear, third-party evidence is needed so that any compostability claim is matched to real operating conditions in Nova Scotia.

This project responds to that gap. We are testing whether locally available agricultural by-products can be upgraded into high-performance pad materials that are designed for organics systems at end-of-life. The intent is not to divert from industrial composting, it is to design for it. Industrial composting is the desired end-of-life stream for this product for cost and convenience to the end user, so our work focuses on producing the evidence that composters and municipalities need to make informed acceptance decisions.

The project also advances Nova Scotia’s circular-economy goals. By turning low-value agricultural residues into a higher-value input, then returning that material to managed organics after use, we keep resources cycling locally. This reduces landfill pressure, supports farmers and processors, and builds the foundation for local manufacturing partnerships and jobs tied to a cleaner materials loop.

Finally, the work aligns with Divert NS and the Solid Waste Strategy. It tackles a persistent plastic-heavy waste stream, improves organics quality by grounding claims in independent testing, and generates practical recommendations for acceptance, labeling, and routing. In short, it is an evidence-first pathway from residue to product to compost, built for Nova Scotia’s systems and stakeholders.

Objectives and Success Criteria

Absorbent core development and testing

Goal: produce functional cores that match or exceed a wood-pulp control under identical conditions.

Success criteria: free-swell capacity at or above control; acquisition time and rewet equal to or better than control; repeatable lab procedure with clear QC gates.

What we did and found: bench-scale cores were produced, benchmarked against a wood-pulp control, and documented with process notes and test sheets. Performance met target ranges for capacity and rewet, with acquisition times within the expected window. These data support moving to extended trials with manufacturing partners.

Testing bulk material properties

Goal: define the feedstock window so materials are stable in storage and predictable in processing.

Success criteria: documented moisture and bulk density ranges, composition data, and a clear contamination threshold.

What we did and found: completed bulk density, moisture, CHN and ash, and heavy-metals screening, along with storage observations. Results establish workable storage targets and show that the feedstock composition is suitable for fibre preparation and core formation.

Compostability and safety testing

Goal: build an evidence set that aligns with industrial composting acceptance in Nova Scotia.

Success criteria: volatile solids at or above 50 percent of total solids; all regulated heavy metals and fluorine below referenced limits; ≥ 90 percent absolute biodegradation at 58 °C within the standard test window; no adverse ecotoxicity signal.

What we did and found: independent testing confirmed volatile solids at 99.6 percent and all measured heavy metals and fluorine below limits referenced by EN 13432, ASTM D6400, and CAN/BNQ 0017-088. Industrial composting biodegradation reached 92.5 percent by day 75 at 58 °C with a valid cellulose reference, meeting the 90 percent criterion. Ecotoxicity is in progress and will be appended on receipt. The tested article was the pad only, without wrapper and release paper, which will be handled in labeling and any follow-on testing.

Unit process equipment testing

Goal: identify practical settings for separation and drying that deliver fibre suitable for downstream forming.

Success criteria: fibre that cards without clumping, a consistent length distribution inside

the defined window, minimal fines, and documented pilot-scale throughput.
What we did and found: prototype equipment and settings were exercised to establish repeatable process windows. The selected approach produced fibre that formed uniform lab webs and supported the absorbent-core trials. Remaining optimisation is tied to scale-up, not technical feasibility.

How we interpret success

Together, these results show that feedstock and processing windows are defined, functional cores meet performance targets, and the pad article meets the key laboratory criteria used to support industrial composting acceptance. With ecotoxicity pending and the final biodegradation report formatting to be filed, the evidence base already supports the project's intent: design for industrial composting as the desired end-of-life pathway in Nova Scotia and provide municipalities and composters with clear, third-party data for acceptance decisions.

Results

Testing bulk material properties

Independent characterization confirmed the pad article is highly organic and within screening limits used in industrial-compostability specifications. Total solids were 94.1%, moisture 5.9%, volatile solids 99.6% lower (on TS), and ash 0.4% (on TS). All measured heavy metals and fluorine were well below the limits referenced by EN 13432 (EU), ASTM D6400 (US), and CAN/BNQ 0017-088 (Canada). These results establish a clean chemistry baseline and validate the feedstock and processing choices for downstream forming.

What this means: the results show that we meet the “chemistry gates” (VS and regulated substances) typically checked before facilities even consider acceptance, and provides targets for storage and preparation (i.e., keep moisture low, minimize ash/contamination).

Unit process equipment testing

Prototype separation and drying runs produced fibre that cards without clumping, with consistent formation in lab webs. Process windows (settings, residence times, blend rules) were documented so future line trials can replicate results. Remaining optimization is scale-related (throughput and continuous handling), not technical feasibility.

What this means: the pathway from residue → fibre → web is reproducible at pilot scale, and ready for extended trials for continuous manufacturing with partner equipment.

Absorbent core development & testing

Bench-scale and industrially manufactured cores were formed and tested side-by-side with a wood-pulp control. Capacity and rewet exceeded the target range, and acquisition time was within the expected window for the selected basis weights. We captured quality control gates (fibre blend, basis weight, compression, cure) so that the same core recipe can be trialed consistently on industry scale partner lines.

What this means: functional cores are available to move into longer, continual production runs; remaining work is finalizing specs after line trials.

Compostability & safety testing

Under controlled aerobic composting at 58 °C, the Aruna Regular Pad reached 92.5% absolute biodegradation in 60 days, exceeding the 90% in 90 days criterion used for industrial compostability. The cellulose reference reached 100%, validating the run.

From the chemistry screen, volatile solids were 99.6% lower (on TS) and all metals and fluorine were well below limits prescribed by EN 13432, ASTM D6400, and CAN/BNQ 0017-088.

In-progress item: the **ecotoxicity (seed germination/plant growth)** test needs to be completed and is currently on pause due to organizational changes, but once this is completed, the full industrial-compostability evidence set will be ready to go.

What this means for Nova Scotia: the product now meets the key laboratory criteria used to support industrial composting as the intended end-of-life pathway in NS where facilities have the technical capacity to accept this feedstock, but with this evidence set, we can advocate for policy change to allow them to accept it. The remaining step is to add ecotoxicity results and engage facilities and municipalities for acceptance reviews using this data package.

Recommendations and Next Steps

1. **Complete the compostability evidence set**
    - Finish the ecotoxicity (seed germination and plant growth) & disintegration test.
    - Apply for and receive certification and prepare acceptance dossier for Canada, keeping scope explicit: results apply to the menstrual pad only.
2. **Move to Nova Scotia facility acceptance**
    - Share the evidence pack with one to two friendly NS industrial composters and agree on acceptance conditions: particle size after shredding, feed rates, screening settings, and contamination controls.
    - Run a supervised acceptance pilot and document diversion, processing behaviour, and quality outcomes for municipal review.
3. **Lock labeling and routing language**
    - Use clear, conservative claims on packaging and web for consumers.
    - Provide facilities with simple routing instructions that reflect operator requirements from the acceptance pilot.
4. **Scale nonwovens and core trials with partners**
    - Use the established process windows to run extended trials. Hold basis weight, fibre blend, compression, and cure within defined gates. Re-confirm capacity, acquisition time, and rewet against the control set.
5. **Stabilize supply and storage at pilot scale**
    - Formalize storage targets based on bulk-property work. Set simple blending rules to manage lot variability before forming.
6. **Track diversion and economics for NS stakeholders**
    - For each pilot month report: tons of residue upgraded, pads produced, estimated plastic displaced, acceptance status, and any quality incidents. This provides Solid Waste Strategy-aligned impact metrics.
7. **Knowledge transfer and communications**

- Publish the findings and recommendations, and presenting information at appropriate conferences for larger scale public awareness and waste management stakeholder engagement.

Conclusion

This project set out to design for industrial composting as the intended end-of-life stream and to generate the third-party evidence that Nova Scotian and Canadian facilities and municipalities need. Independent testing confirms that the pad article meets key laboratory criteria used to support industrial compostability and safety. Volatile solids measured 99.6 percent of total solids, and all tested heavy metals and fluorine were below referenced limits. Under controlled aerobic conditions at 58 °C, the pad reached 92.5 percent absolute biodegradation by day 60, with the cellulose reference exceeding 100 percent, which validated the run.

Operationally, process windows were defined for unit-process equipment, uniform lab webs were produced, and functional absorbent cores met target ranges for capacity and rewet with acquisition times in the expected window. Taken together, these results show technical feasibility and a credible path to provincial acceptance. Completing ecotoxicity, running a supervised facility pilot, and finalizing labeling and routing language are the final steps to translate this evidence into on-the-ground diversion and circular-economy benefits for Nova Scotia.