



Plastic Composites

PLASTICS RECYCLING CHALLENGES



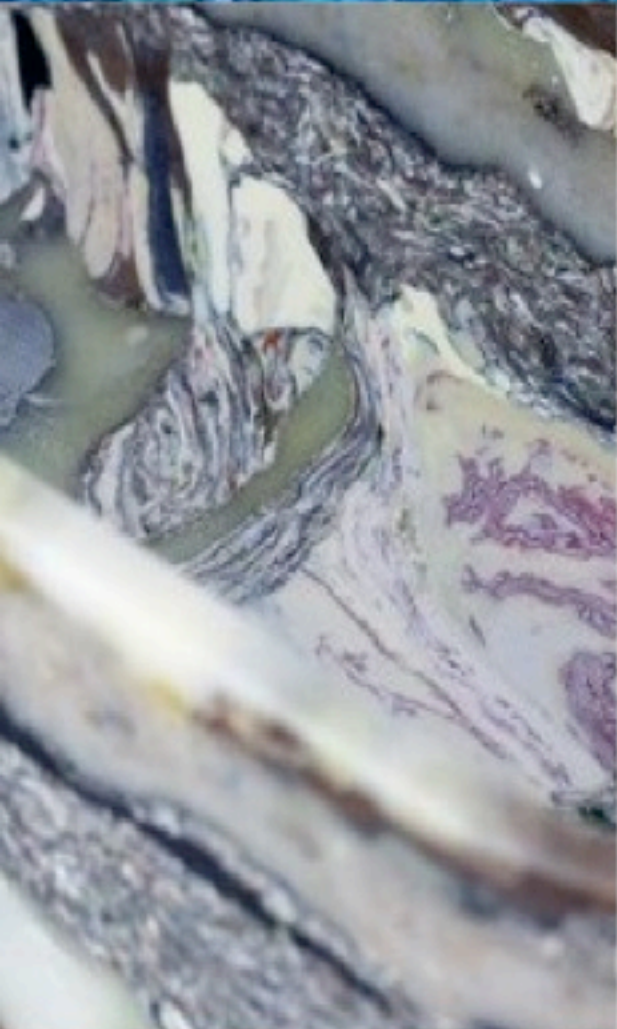
- The imperative for recycling plastic waste has always been financial.
- Related environmental and health issues require attitudinal changes beyond the scope of any commercial entity or any single government.
- Plastic polymer recycling is often more challenging because of its low density and low value – hence less financial incentive.
- There are more technical hurdles to overcome when recycling plastic than with most other products.

PLASTIC POLYMERS



- Plastic polymers are macro molecules which interact along their entire length.
- As a result, the total energy involved in mixing it is largely due to the nature of the product; its internal energy value (plastics are fossil fuel derivatives), and the amount of external energy required (heat) to displace its environment and establish its volume and pressure – the melting process.
- Heat alone will not dissolve large molecules, so plastics of nearly identical composition are usually needed to mix efficiently.

ADDITIONAL COMINGLING CHALLENGES



- When different types of plastics are melted together, they tend to phase-separate, like oil and water, and set in these layers.
- The phase boundaries cause structural weakness in the resulting material, meaning that polymer blends are useful in only limited applications.
- Tower Technologies set out to overcome some of these challenges with a new approach that will consume meaningful quantities of waste and create valuable, usable products at a lower energy cost.

TOWER'S APPROACH TO PLASTICS



Take the two plastic polymer waste streams that are most difficult to decompose, and most prolific,; high density polypropylene (HDPE) and polyvinyl chloride (PVC). micronize them, and use them as a binder for other substrates including:

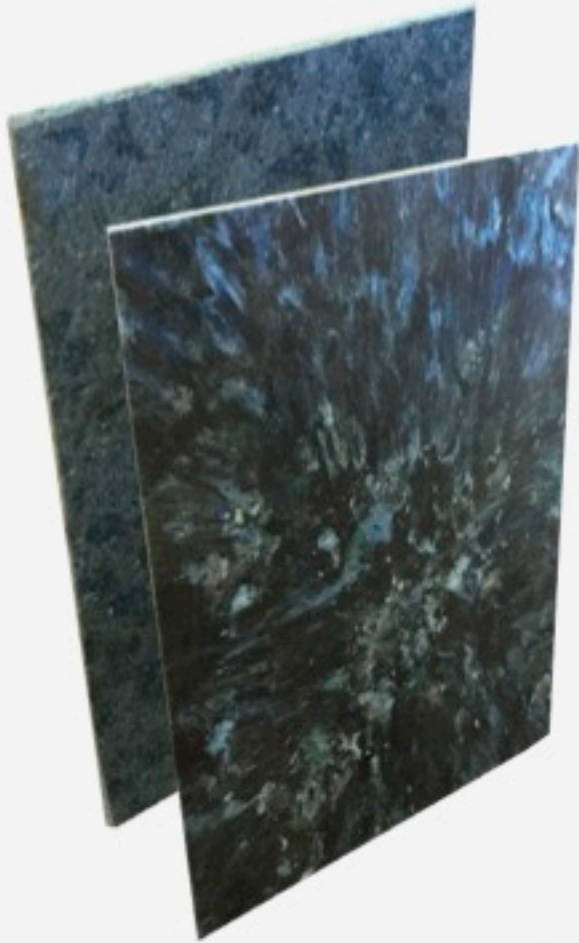
- Wood waste
- Leather waste
- Carpet for quality and strength – not melted
- Other plastic shred provided it is consistent
- Glass
- Paper or paper pulp sludge

TOWER'S OBJECTIVES WITH PLASTICS



- Create products of a good appearance.
- Give them the required strength and stiffness.
- Make them resistant to water.
- Make them tough when they need to be reused.
- Make them easy to cut or nail.
- Make them recyclable.
- Render them biologically inert due to the pasteurization temperature of the process.

OUTCOMES



- Two patents covering the combination of various micronized polymers in combination with suitable resins that can then be pressed at 10 Bar, at temperatures of between 130 and 150 degrees centigrade, with a dwell time of 10-30 seconds per millimeter of thickness to either a flat or shaped profile.
- To ensure uniformity the micronized polymers are adhered to the feedstock using a special resin.
- Thin composites (up to 12mm) are preferred, formulated for maximum strength.

SOME SUITABLE PRODUCTS



- Substrates can be synthetic or natural. Excellent hardboard products can be produced from agriwastes.
- Tower have developed processes for waterproofing these natural fibers prior to them being mixed and compressed, providing superior water resistance for shutter boards, roof shingles and more.
- Food-grade pallets, reusable form boards, double-skinned shutter boards, attractive roof shingles, floor tiles, high density fiberboard and waterproof siding can all be formulated economically.

OTHER QUALITIES



- Tower Plastic Composites can be as thin as two millimeters to a maximum of 12 mm.
- Water uptake after 24 hours is less than 1.5%.
- There is Zero thickness swell when immersed in water.
- The products are proof to insect and biological attack.
- The products optimize the best qualities of both the polymer binder and any fibrous substrate being used. Strength, toughness and flexibility.

CHOICES RELATED TO POLYMERS



- Some polymers are easy to micronize, others have better flow characteristics.
- The best waterproofing agent is EPS foam, milled, extruded then ground.
- The best binder is unplasticised PVC.
- The best for toughness is HDPE.
- Linear low density polyethylene is no good for strength but excellent as a water proofer.
- Polypropylene is also strong as a binder.
- Post lamination with resin impregnated or glass impregnated paper adds stiffness.

THE CASE FOR SHUTTER BOARDS



Shutter boards are typically produced from high quality plywood, with a surface laminate of pure resin as a release surface.

- They are light and very strong.
- On the downside, if not of marine grade ply, they absorb up to 40% by mass of water, resulting in strength reduction up to 50%.
- They may be degraded by both microorganisms and insects.
- They have a high cost per square meter.
- They are not recyclable and are sourced from trees that have a long growing cycle.

TOWER'S SHUTTER BOARDS



- Tower have spent considerable time researching and testing shutter boards made using its plastic composite technologies.
- They are constructed from a blend of micronized HDPE bound with unsaturated polyester resin and a heat sensitized catalyst.
- A volume extender such as perlite or vermiculite is added to control final density.
- It is further reinforced with fibers, preferably polyethylene terephthalate.
- An optional outer lamina layer can be added for aesthetics.

EXCEPTIONAL PROPERTIES



- The result is a strong board with a stiffness exceeding 50mPa.
- Water proof with a water absorption at 24-hours of less than 1%.
- Tough enough to withstand rough handling on site.
- End-of-life recycling into the same product.
- The ideal shutter board.
- Anywhere form-board is used: floors of reloadable buildings, dividers or cubicles in schools or clinics that require to be aseptic, exterior signage.

KEY POINTS TO NOTE



- Lower Energy costs
- Wider range of beneficial properties
- Substrates can include any shredded waste plastic, natural or synthetic carpet fiber, wood or grain biomass.
- The micronized plastic acts as a co-binder and waterproofing agent.
- The resin acts partly as a binder but is primarily used to prevent particle separation.
- Dwell time in the press sterilizes and takes the particles through the glass transition point (TG) to the point of binding.

TOWER GETS ALL THE GREEN TICKS



Prevents emissions of greenhouse gases



Reduces pollutants



Reduces the cost of manufacturing



Recycles raw materials



Conserves energy and water



Stimulates development of green technology

LICENSING ENQUIRIES



**Tower Technology Holdings Pty Ltd
Bldg 16, CSIR, Meiring Naude Road
Scientia, Pretoria 0181, South Africa**

info@tower.co.za

Joanna Symons +27 (0)8 2318 3476