A functional environmentally safe plastic, designed for the circular economy

Aquapak's Hydropol™ is a specially engineered material that can create a range of packaging products that are designed to eliminate plastic pollution at source

Hydropol End-of-Life Overview

Biodegradation

Aquapak's Hydropol™ will disintegrate and completely biodegrade over time in both aerobic and anaerobic conditions.

Industrial (Municipal) Composting

ISO 17088
Hydropol™ 33101P (20-25µm) has been certified against ISO 17088-2012 (Specifications for Compostable Plastics) by India's CIPET laboratory. The analysis used test method ISO 14855-1 (Determination of the Ultimate Aerobic Biodegradability of Plastics). The film reached 90.07% of biodegradation within 101 days, well below the threshold time limit of 90% within 180 days. A copy of the test report/certificate is available on request.

EN13432
The harmonised European Standard for specifying industrial compostability of packaging is EN13432. The compostable plastics protocol designated EN14995 follows the same test procedure as EN13432. There are 4 main parts to the test: 1) distintegration/fragmentation; 2) biodegradation; 3) ecotoxicty; 4) compost quality.
All are measured against a cellulosic standard.

Hydropol™ films have higher strength and other improved mechanical properties over existing compostable materials. As a result of this improved strength, they do not fragment quickly enough under the EN13432 test criteria in comparison to the less robust traditional compostable materials. Whilst all Hydropol film will biodegrade in composting conditions the actual claim for compostability can only be met by adhering to EN13432 testing and therefore Hydropol™ film is much more gauge dependent than weaker products. However, Aquapak has historical independent test data and ongoing tests on Hydropol™ which confirm by testing and extrapolation under EN13432 protocols that not only is biodegradation occurring but EN13432 can be achieved depending on the Hydropol™ version and the gauge of the film.

Warm water soluble (33100 and 55100 series) Hydropol film is expected to pass the requirements of EN13432 at a gauge of 20µm.

Hot water soluble (30100 series) Hydropol film is expected to pass the requirements of EN13432 at a gauge of 15µm.

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ISO 14851- Aerobic Biodegradation

Pellets of 30164P (representative of 30100 and 50100 series Hydropol) and 33104P (representative of 33100 and 55100 series Hydropol) have been proven to biodegrade using test method ISO 14851- Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium- Method by measuring the oxygen demand in a closed respirometer.

> 30164P achieved a degradation plateau at day 95 as determined by a non-linear curve fit of the data for oxygen consumption. Consumption of O2 by the test system indicated that the test sample biodegraded to 34% ThOD after 95 days of testing.
>
> 33104P achieved a degradation plateau at day 85 as determined by a non-linear curve fit of the data for oxygen consumption. Consumption of O2 by the test system indicated that the test sample biodegraded to 18% ThOD after 85 days of testing.

The full test report can be found on our website:
https://www.aquapakpolymers.com/wp-content/uploads/Aquapak-Report.pdf

Anaerobic Digestion
This method is used for converting food waste into bio-gas which can then be used for energy generation and also produces biodigestate, a valuable fertiliser. Unusually, as most plastics are not, Hydropol™ films are compatible in AD systems. Clearly the gauge of the film, hydrolysis of the product and the type of AD system are critical. Film in the range 20-35µm of both fully and partially hydrolysed film will breakdown in thermophilic units within the normal operating dwell time. The thicker gauges of fully hydrolysed film require a hydro-treatment or pre-conditioning tank prior to entering the AD tank to enhance speed of breakdown. Nearly all AD systems require post pasteurisation to kill pathogens and this process will breakdown any residual Hydropol material in both systems.

Landfill
Films tested pass criteria for disintegration in anaerobic conditions. This data allowed a calculation to meet the requirements of anaerobic landfill conditions according to ASTM D5526 AD.

Recycling

Mechanical Recycling
Hydropol™ is a thermoplastic polymer, therefore can be mechanically recycled back into pellet. This works well in closed capture loops, such as retail, where Hydropol™ can be collected in bulk.

In mixed household recycling, Hydropol™ can be identified and separated using Infra-Red. If this is not available, then hot wash will dissolve the Aquapak resin allowing recovery and without contaminating other plastic streams.

Unfortunately, the reality of most standard recycling plants across the globe is that they concentrate on 2 or 3 plastics that have the largest quantities and therefore the most value when recycled (such as PET). This means that they are not set up to capture Hydropol™ (or other flexible films) and enable its reuse. Aquapak welcomes discussions with waste

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recycling plants and film manufacturers on setting up such systems as Hydropol™ is designed for the circular economy.

Hydropol™ is an enabling technology. Combined with other polymers, it can provide great barrier properties and strength and be recycled within the polyolefin-based flexible packaging waste stream.

Based on CEFLEX's Designing for a Circular Economy Guidelines which gives practical support and advice on circular economy design principles, we can confirm that Hydropol™, being a PVOH compound and when providing barrier properties for polyethylene (PE) and polypropylene (PP), would be compatible with the Ceflex guidelines, in that it can be used up to 5% in the total structure of the material and be deemed compatible with PE and PP mechanical recycling.
In addition, CEFLEX are currently testing Hydropol™ to confirm that it can be sorted and separated using Infra-red in a multi-layer packaging structure and will use this data to update their Guidelines to advise the value chain.

Paper Re-pulp
There is no international test method for recycling paper. We use ISO 5263:1 (laboratory disintegration of chemical pulps) to model conditions in a paper recycling plant as closely as possible.
Hydropol™ 33100 and 55100 series repulp at 40°C (the mostly commonly used water temperature) with high levels of fibre recovery.
Extensive work carried out in conjunction with DS Smith and Axchem has shown that Hydropol™ has no detrimental effects in the paper recycling system and can be found on our website:
https://www.aquapakpolymers.com/request-white-paper/
https://www.aquapakpolymers.com/request-white-paper-2/

Water Soluble
Films of Hydropol™ 30164P dissolve quickly and completely at 65°C. In colder water dissolving will take longer, but this will not prevent the material biodegrading.

Hydropol™ 33100 and 55100 series are designed to dissolve quickly and completely at 40°C as a film to ensure compatibility with paper recycling systems.

There is no international test method for water solubility. Aquapak use an in-house test method to determine the temperature of solubility (AQU QA LAB SOP 4.0 is available on request). We intend to work with the ASTM to develop a suitable standard for water solubility of plastics.

Marine Safe/Accidental Feral Release
The material itself is not toxic as shown by the OWS (Belgium) results using the Daphnia test protocol for ASTM D6691 and OK Marine. Full results were also obtained for green algae and water fleas. There is no standard test method for animal consumption, and we are reluctant to engage in further animal testing to confirm existing results. The international test methods for marine safety defining the use of Daphnia etc. are recognised as defining the behaviour of the material in the entire food chain. This is to avoid testing on higher animal species.

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PVOH is a hydrophilic polymer unlike most conventional polymers which are hydrophobic. There are many documented studies confirming the accumulation of toxins and harmful pathogens onto the surfaces of hydrophobic plastics like polyethylene. Hydrophilic plastics like Hydropol™ show no bioaccumulation.
This is an area where standards are being re-written as it has been realised that current Standards and test methods do not adequately reflect real behaviour in many environments.

In order to overcome the constraints posed by existing test methodologies, we have begun a collaborative project with Herriot-Watt University, who are recognised globally as experts in ecotoxicity of materials, to assess the true effects of Hydropol™ in the ocean in comparison to existing materials such as PE.

Summary

It should be noted that Aquapak has not moved to certify Hydropol™ as the samples were internally produced on our pilot equipment for indicative purposes only. The testing was undertaken to establish the behaviour of Hydropol™ in its expected end-of-life environments. It is normal commercial practice that the product actually entering the market from the film producer requires certification to substantiate a claim.

Aquapak regularly screens and independently tests its materials for a wide number of end of life and disposal options in order to help customers who are producing their own finished goods based on Hydropol™ to obtain certification.

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