

Energy Saving Trust Report

Endo Enterprises

***EndoTherm™ Central Heating system
Additive***

Product Performance Services

From: Energy Saving Trust

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Energy Saving Trust – Product Performance Verification

Client: Endo Enterprises

Address: Unit 231, Europa Boulevard, Gemini Park, Warrington, WA5 7TN

Product: EndoTherm – Energy Saving Additive for Central Heating Systems

Background

Endo Enterprises has contracted the Energy Saving Trust (EST) to undertake a review of evidence provided about the performance of EndoTherm, their central heating system additive. The desired outcome is that EST will be able to verify performance claims that the product can generate energy savings when introduced into a central heating system. Endo Enterprises have provided data and reports for EST to evaluate, including a test report carried out by an independent laboratory, results of an independent field trial and a number of non-domestic in-situ case studies.

Description of EndoTherm

EndoTherm is a product that can be added to the water in a central heating system which Endo Enterprises claims to be able to generate energy savings of up to 15%. The product is most commonly sold into the non-domestic market.

For the first year of operation, Endo Enterprises provided the product on a ‘no savings, no fee’ basis which seems to have been a successful approach to getting the product into an otherwise sceptical market. A 500ml bottle of EndoTherm is suitable for treating an average-sized UK house, costing approximately £40 and can easily be installed by the householder. It can be added either at the feed / expansion tank or at a partially drained radiator.

Endo Enterprises state that EndoTherm reduces the surface tension of water by over 60%. This allows EndoTherm to improve the heat-transfer properties of the water in central heating systems. Endo Enterprises claim that this allows EndoTherm to enable more effective transfer of heat, allowing radiators to heat up quicker and reach the room’s temperature set-point faster.

Endo Enterprises claims that radiators will stay hotter for longer and the return temperature of water to the boiler will be lower, improving the condensation process in condensing boilers. Radiators typically contain microscopic imperfections on the internal surfaces, for example very small pits and cavities, and these result in optimal thermal contact not being made between those surfaces and the water in the central heating system. As EndoTherm alters the surface tension of the water, Endo Enterprises claim these imperfections are able to be filled, improving thermal contact and the heat-transfer rate. Endo Enterprises claim that all these attributes enable thermostatically set temperatures to be reached and maintained while consuming less fuel. Further illustrative detail of this effect is shown in Appendix 1.

Factory Visit – 31st October 2016

James Russill, EST Technical Development Manager, visited the Endo Enterprises head office and manufacturing site in Warrington on 31st October 2016. The purpose of the visit was to inspect the manufacturing process and check the companies ISO 9001 quality management system.

Various aspects of the manufacturing process were discussed and the Endo Enterprises quality management system reviewed, summarised below:

- A clear procedure exists for the formulation of EndoTherm solution
- Raw materials are analysed before use, to establish that it meets the desired technical specification
- A sample of each batch manufactured is clearly labelled and retained in the laboratory
- All EndoTherm product is traceable back to an original batch number
- An associated paper trail exists for each manufactured batch of EndoTherm
- All procurement and manufacturing processes are documented in an accredited ISO9001 quality management system
- The Endo Enterprises quality management system is accredited by ISOQAR, certificate number 12560-QMS-001 dated 7 October 2014; certificate expires 7 October 2017

Supporting Evidence of Product Performance

Endo Enterprises has supplied a range of product performance data, ranging from laboratory testing to field trial data to case studies of both domestic and non-domestic sites. The key documents reviewed are summarised below.

Independent Laboratory Testing – ENERTEK International

EndoTherm has been tested by ENERTEK International, an independent test house based in East Yorkshire. The organisation operates under an ISO 17025 Quality Management System. Testing of EndoTherm was conducted in 2014, running a boiler for 24 hour periods with and without the application of EndoTherm.

The results are presented in report E3363, dated 14th January 2014.

When operated under the test conditions described within this report, the addition of EndoTherm solution to the heating system water resulted in a reduction in the gas consumed by the heating boiler of up to 15% within the 24hr test period. The test was carried out on a laboratory set-up which may not be reflective of all domestic heating systems

Trivallis Housing Association Field Trial Report

This report presents the finding of a field trial, undertaken independently from EndoTherm by an environmental consultancy called Atega. EST has used Atega services in the past, mainly for training provision. The study involved 7 properties in total, but one of the properties became void and was therefore removed from the final analysis. The field trial resulted in 2 properties acting as a 'control group' and receiving a power flush treatment, while 4 properties received power flushing plus a dose of EndoTherm. The properties were located in the RCT Homes sheltered accommodation scheme in Fanheulog.

The headline conclusions were that power flushing resulted in energy savings of 7.36% while power flushing plus EndoTherm treatment generated energy savings of 21.35%. An energy saving solely

attributable to EndoTherm was therefore calculated at 13.99%, with a range of savings between 10.85% and 19.36%. However, the extent which the energy savings were due to EndoTherm itself and the extent which energy savings were due to changes to the heating control settings in the properties following the EndoTherm treatment is unknown. The extent to which EndoTherm would provide savings in a system which has not been power flushed is also unclear (by cleaning the system and increasing the available surface area for heat transfer, a power flush may act to increase the effectiveness of EndoTherm).

While clear energy savings are shown, a larger sample incorporating the main house types present in the housing stock would be required before making generalised energy saving claims that would be applicable to the UK housing stock.

Durham University – Case Study

The study involved the Mountjoy centre, which houses the University's offices. Heat is provided by 2 x 200kW boilers. A 12-month monitoring period with EndoTherm installed was carried out up until April 2016 and was compared to data from the previous 12 months. Savings were calculated using degree day analysis and showed an energy saving of 7.84%.

Middlesbrough Council – Case Study

EndoTherm was initially trialled in December 2014 at their head office, the CIVIC centre. The council's sites do not have a BMS installed or Half Hourly data but there were systematic readings taken at the end of each month which formed part of the council's efforts to ensure their billing was correct. Due to this, a direct comparison of December – April (5 months) of 2014/15 was compared with 2013/14. This comparison showed a 20.56% compensated saving using degree days.

NATS Air Traffic Control Centre, Ayrshire, Scotland – Case Study

A large non-domestic site, heating provided by 5 x Ferroli 247.5KW boilers. Monitoring performance with the heating system treated with EndoTherm was carried out over 10 months and showed a 16.36% energy saving when compared to data from the previous year. Savings were calculated using degree day analysis.

Chesterfield NHS – Beech Court & Willow Court

Beech Court involved a trial of EndoTherm in a 10-bedroom staff accommodation block. Regression analysis utilising degree days was again used to determine energy savings from the application. A 10.38% energy saving was observed with positive feedback from the NHS energy manager. Willow Court was a similar 10-bedroom staff accommodation block, treated with EndoTherm and observed over a 7-month period. In this instance a 13.67% energy saving was reported.

University of Central Lancashire

UCLAN conducted research in a test room incorporating a gas condensing boiler. Running testing with and without EndoTherm over a 5-hour period resulted in a conclusion that 10.4% fuel had been saved when EndoTherm was added to the heating water. Trends seen in some of the other research provided by Endo Enterprises were also noted such as water heating up quicker, lower return temperatures, more heat being emitted into the room and room setpoint temperature reached faster.

Boiler Manufacturer Comments

Endo Enterprises have provided comment from boiler manufacturers that confirm they accept the use of EndoTherm in conjunction with their boilers.

Baxi: "Please find confirmation from this letter that Baxi accept the EndoTherm product as an additive for central heating for use with our boilers but we will neither confirm or deny its performance thermally".

Vaillant: "having had a look through the data provided is happy that the use of the EndoTherm product shouldn't affect the boiler warranties and any possible water testing results. Barney also heads up our Vaillant Solutions programme so if he is happy then I am totally comfortable with the use of the EndoTherm product".

Conclusion

Endo Enterprises have provided a set of evidence relating to the in-situ performance of EndoTherm, comprising independent test data, a small domestic field trial, laboratory data and non-domestic case studies.

The key objective of the project was to determine whether EST can verify the claim that applying EndoTherm into a central heating system can generate energy savings. While not enough evidence is presented to support an 'up to 15% energy saving' claim in all cases, EST can verify that applying EndoTherm has resulted in a reduction of energy and fuel consumption in the cases investigated.

Laboratory testing, and studies carried out in samples of domestic and non-domestic properties, shows that EndoTherm has been effective in reducing energy and fuel consumption with condensing boilers. *

Caveats

**These results are specific to the case studied. Similar performance improvements may not be realised in other heating systems. Potential performance improvements depend on the current performance, condition and settings of the heating system. Based on performance data and instances reviewed comprising results from Enertek test report E3363 (dated 14th January 2014); Trivallis field trial report from Artega and non-domestic case studies. Correct as of January 2017 and valid for 12 months.*

EndoTherm™

Laboratory testing, and studies carried out in samples of domestic and non-domestic properties, shows that **EndoTherm™** has been effective in reducing energy and fuel consumption with condensing boilers



*These results are specific to the cases studied. Similar performance improvements may not be realised in other heating systems. Potential performance improvements depend on the current performance, condition and settings of the heating system. Based on performance data and instances reviewed comprising results from Enertek test report E3363 (dated 14th January 2014); RCT Homes field trial report from Artega and non-domestic case studies. Correct as of January 2017 and valid for 12 months

NOTES relating to the use of the above claim and caveat:

- The evidence is limited to proving an energy saving benefit only when EndoTherm is used in conjunction with a condensing boiler.
- The verified claim is based on the information reviewed by EST as summarised in this report, and that in the scenarios reviewed energy savings were generated.
- Verified claims must be used in conjunction with the caveats agreed with EST
- Information contained in this report correct as of January 2017
- Verification of EndoTherm claims valid for 12 months as of January 2017

Limitations

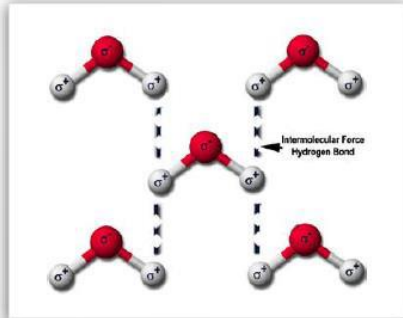
The main limitations to the claims we are able to verify are:

- Domestic trial is of too few properties and too few types of heating systems to represent all heating systems generally.
- The non-domestic case studies have been selected by Endo Enterprises and may not represent all cases where Endotherm has been applied.
- Laboratory test conditions have not been designed to be representative of a typical domestic setting.

Appendix 1 – EndoTherm Technical Detail.

The following is the explanation provided by Endo Enterprises of the mechanism that leads to energy savings in heating systems following the application of EndoTherm.

Water has a high surface tension caused by Hydrogen Bonding!



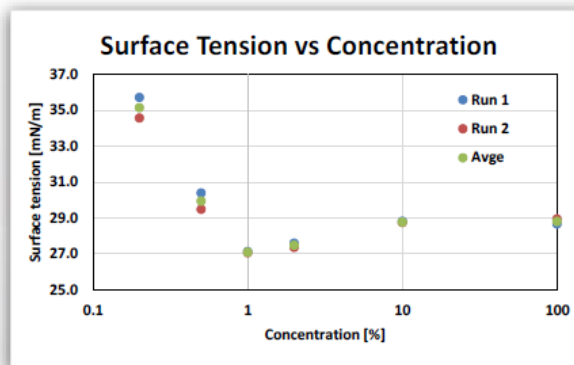
A water molecule can form 4 hydrogen bonds with 4 other water molecules.

A hydrogen bond in water the electrostatic attraction between a hydrogen (H) atom and a oxygen (O) that it isn't already covalently bonded with. This gives water a high surface tension compared with other liquids.



EndoTherm breaks down hydrogen bonding:

- Reduces Surface tension (60%)
- Water has a surface tension of 72.75 mN/m at 20°C*

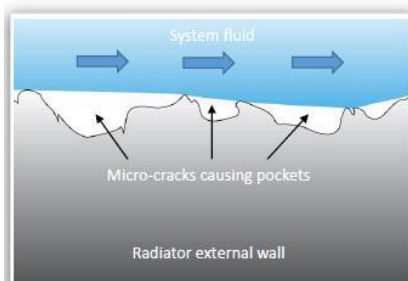


A 1% EndoTherm solution is the critical micelle Concentration with a mean surface tension of 27.1 mN/m

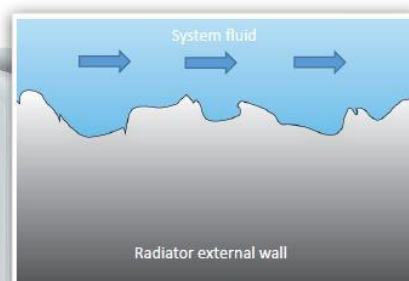
LPD Lab Services: Report Number L70 (24/02/2015).
*<http://www.nist.gov/data/PDFfiles/jpcrd231.pdf>

Under a Microscope, Smooth Surfaces Aren't Smooth!

The inside of plastic/metallic surfaces are full of micro-cracks and imperfections.



Water only



EndoTherm

**A Reduction of Surface Tension Increases Cross-Sectional Area
Alters heat transfer coefficient**

EndoTherm[®] Increases the Overall Heat Transfer Coefficient

$$Q = U.A.\Delta T$$

Q = Rate of heat transfer

U = Heat transfer coefficient

A = Cross-sectional area for heat transfer

ΔT = Temperature difference (between radiator and room)



EndoTherm[®] improves the rate of heat transfer by increasing the contact area and heat transfer coefficient on the water side of the radiator

EndoTherm Endorsements

