

The Grease to Greece Rally 2008 - Trip Report

Abstract

The Grease to Greece Rally was the first successful attempt to drive a large convoy of vehicles (10) across Europe fuelled by waste vegetable oil sourced locally during the trip from restaurants.

The project was designed to test the feasibility of using fuel sourced in this way to sustainably power trans-European motoring.

The project is a follow up to the Chocolate Powered Lorry expedition to Timbuktu using biodiesel made from waste cocoa butter.

Authors and Organisers

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Background Links

The Grease to Greece Rally www.fatfinding.com

The 2008 rally was sponsored by

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Objectives

Aim

The aim of the trip was to discover if a Trans-European driving expedition could be powered by local sources of waste vegetable oil, collected en-route without pre-arrangement or pre-planning.

Can the bins of Europe's restaurants and burger bars be used as a network of fuel stations?

Background

Typically restaurants store the waste oil from their fryers in a vat near their bins. The oil is collected by waste disposal companies on either a regular collection round, or at the request of the restaurant when the vat is almost full.

Any venue with a fryer has waste oil it needs to dispose of. This includes fast food restaurants but also hotels, hospitals, care homes, schools, and many other venues that are outside the greasy stereotype.

Some regions in Europe have strictly enforced regulations which require restaurants to maintain paperwork to account for the transfer of their waste oil to an authorised disposal company. In other regions the regulation is so poorly enforced that restaurants routinely throw their waste oil into the sewer.

Technical Terminology

WVO	- Waste Vegetable Oil
Micron	- 0.001mm
Trans-Esterification	- The reaction to convert vegetable oil into biodiesel

The Grease to Greece Rally

On August the 16th 2008, 10 cars set off on the **Grease to Greece Rally** driving from London to Athens powered only by waste vegetable oil that they would have to scavenge from restaurants along the way.

People

The teams had been brought together from a variety of backgrounds, with a range of experience in running cars on vegetable oil, from novices to professional biodiesel suppliers.

Amongst the teams were engineers, a policeman, an accountant, a school teacher, mechanics, a writer, a gardener, several businessmen, a farmer, a physiotherapist and students.

Cars

The following 10 diesel engine cars were used for the rally;

- Peugeot 405 Estate (1995)
- Peugeot 405 Saloon (1995)
- Peugeot 306 (1996)

- Peugeot 406 (1999)
- Ford Transit (1998)
- Audi 80 (1991)
- Mercedes 300D (1990)
- Landrover Discovery 300TDi (1997)
- Support Vehicle - Citroen Relay (2005)
- VW Touareg (2006)

Route

The route from the UK followed an almost straight line between London and Athens.

Teams were free to choose their own route during the day and we regrouped to spend nights at campsites in the following places:

- Calais, France
- Nurburgring Race Track, Germany
- Munich, Germany
- Bormio, near the Stelvio Pass, Italy.
- Venice, Italy (2 nights)
- Raca, Croatia
- Maraska, Croatia
- Budva, Montenegro
- Ionnina, Greece
- Athens, Greece

We drove through the following countries;

UK, France, Belgium, The Netherlands, Germany, Austria, Italy, Slovenia, Croatia, Bosnia Herzegovina, Montenegro, Albania and Greece

Vegetable oil to fuel

There were 2 approaches used by the teams on the rally. 6 teams had converted engines that would run on vegetable oil, and the other 4 used the oil to make biodiesel for their unconverted engines.

Converted Engines

It is beyond the remit of this trip report to explain how vegetable oil engine conversions work in detail.

Vegetable Oil conversions ranged in simplicity from no modification (Mercedes 300D) to a computer controlled twin tank system (Peugeot 405 Estate).

The warm temperatures of the European summers meant that cars started and ran fine on vegetable oil.

Biodiesel Processor

Four unconverted cars used biodiesel for the journey.

Biodiesel was made with the WVO collected by those teams and trans-esterified in a Green Fuels Fuelpod2 processor during the trip. To maintain the integrity of the expedition's ambition not to use fossil fuels, bio-ethanol made from cheese whey was used in the reaction and the processor was powered by a small diesel generator running on biodiesel, all of which was transported by Green Fuels in the support vehicle.

Oil Collecting Equipment

An important factor in being able to take full advantages of "oil finds" was having the correct equipment to extract the oil from the vat in which it was stored by the restaurant.

At the bottom of the vat there was usually a sludgy oil-water mix. Our collection techniques required us to leave this untouched.

Pouring and tipping from the vat results in disturbing the sediment so had to be done with great care and was not a very efficient way of collecting the oil without the sludge. Some vats were too big to lift and pour from.

We used clear 3/4" tubing as a siphon starting the siphon by mouth. We also used a 12v pump which was helpful when our car (battery) could be positioned close enough to the vat.

The collection hose was held just below the surface of the oil to minimise the sediment being sucked up from the bottom of the vat.

Other teams used a hand pump which worked well but was physically demanding and a drill pump which although portable struggled both to prime itself and with the viscosity of the oil.

Narrower tubing resulted in frustratingly slow transfer of oil.

Opaque tubing made it impossible to monitor the quality of the oil being transferred (to determine when the sediment level had been reached), and to see any air bubbles that were preventing the siphon from working.

A torch proved useful to check the quality of the oil before starting to collect it.

As well as the 60 litre standard fuel tank fitted to our Peugeot 405 we also had a capacity of 6x20litre plastic jerry cans. Most teams had a similar oil carrying capacity.

Filtering the oil

For WVO to be successfully used as a fuel it has to be cleaned, which means removing particulates larger than 5microns, and dewatering.

Most car fuel filters work at 5microns and the injection system can cope with particulates of that size and smaller. To prevent the car filter from blocking rapidly the oil must be filtered to 5microns or less before being put into the car's fuel tank.

The international standard for mineral diesel requires that it doesn't contain particles larger than 1micron

Water mixed with the oil can be seen as cloudy and has a sludgy consistency. This will also block the fuel filter and can cause damage to the inside of the engine cylinder during combustion.

Some teams used a series of filters. Team **Greece Monkeys (Mercedes 300D)** had the most sophisticated multi-stage filtering system; 200 micron gravity fed pre-filter sock, then hand pumped through 20micron and 5micron cleanable filters. This worked well for dry (sludge free) oil, but cloudy oil quickly blocked their pre-filter sock. As a result they had to be more selective about the oil they collected.

Team **Fat Lot Of Good (LandRover Discovery 300TDI)** used a pair of tights to filter their oil. We estimated this to be equivalent to a 50-100 micron filter and was largely ineffectual resulting in regular fuel filter blockages.

Our team, **Grease Junkies (Peugeot 405)**, used a centrifuge which was designed to trap particles and water in the main housing and only let clean oil pass. The oil had to be heated before passing through the centrifuge to make it viscous enough for the centrifuge to separate the oil, water and debris effectively.

The pump powering the centrifuge required the oil to be pre filtered to 100microns (achieved with a muslin cloth over a funnel) to protect the workings of the pump.

The centrifuge is rated as <1micron filtering efficiency.

Although it worked well, it struggled to dewater very cloudy oils and with hindsight we think very cloudy oils would have benefited from multiple passes through the centrifuge.

Our centrifuge was powered by a 12v pump running from the car battery. The oil was heated in a heat exchanger warmed by the engine coolant. Therefore all the energy for the filtration came from the engine running on waste vegetable oil so this system had no carbon emissions from fuel transportation or processing.

20 litres of WVO could be cleaned with the centrifuge in around 5 minutes and in practice we collected oil during the day and centrifuged it in the evening in readiness for use the next day.

Legality

Since June 2007 UK Customs and Excise have created a 2500ltr allowance for individuals running their car on vegetable oil or homemade biodiesel for personal use. Drivers don't need to declare it or pay fuel duty on it.

Although this was done because collection and enforcement became more expensive than the tax revenue, it has proved to be a very environmentally friendly policy which has effectively led to a very efficient network of collection and recycling of waste vegetable oil from waste producers.

However this is not the case in Europe so there is an ample supply of waste vegetable oil available, but there remains a great deal of confusion over where and if fuel duty should be paid on waste oil collected in Austria and used in Italy by a British car for example.

Our research included contacting the tax authorities in Austria and Germany, where we thought there was the highest likelihood that they would enforce tax on vegetable oil used as fuel.

In both cases their response made it implicitly clear that because of our short transit through these countries, high media profile, and our non-national status, we were unlikely to come to the attention

of the tax authorities. In both cases the officials providing the information wished us luck and thought what we were doing was very funny.

Observations

We managed to collect WVO in every country along the route apart from Albania, Slovenia, Bosnia, The Netherlands and Austria, but this had more to do with the brief time we spent in each of these countries and isn't necessarily a reflection of the availability of oil.

Oil Finds

Teams had a range of experiences while searching for oil; sometimes easy, sometimes hard, which would imply that luck had a large part to play.

All the teams were provided with a road book that had translations in all the local languages explaining that they needed waste oil and explaining what for. However a rudimentary grasp of the local language proved a big advantage.

Oil quality

The worst quality oils were the supplies we found in the UK before the start of the rally.

The best quality oil came from a high end Bavarian restaurant. The vat was stored in an air conditioned bin room which made it difficult to pre-filter as it solidified on contact with our cold metal sieve. Despite this it was lovely looking oil, clear and light, it was easy to filter and was so plentiful we couldn't carry it all away.

During the trip we formed the conclusion that a combination of factors resulted in good quality oil.

- A sealed vat, so no rain water could get in.
- A dark vat in direct sunlight warmed and thinned the oil, allowing the water and debris sediment to settle more effectively.
- Regular changes in fryer oil meant that the oil was less saturated with water or food.
- A choice of good quality oil for the fryer. Invariably the best oil came from restaurants that served the best food.

Germany and Italy had consistently good quality oil, clean and dry. The exhaust smell did not have a food type associated with it, implying that our filtering system was able to thoroughly clean it of food debris.

Greek oil, although plentiful was usually used to fry fish, so had a high water/sludge content. Great care had to be taken with Greek oil, to stop sucking when the siphon reached the sediment layer, but often this was gradual change because the vat had not had time to settle thanks to regular fryer changes being added to the vat and unsettling the oil. Using this oil produced a distinct fish smell at the exhaust implying it was not fully cleaned by our filtration system.

Paying for Oil

No teams were ever asked to pay for oil they collected.

In Munich we discovered that restaurants do sell their WVO for a small fee to waste collection companies.

Availability

A certain amount of luck and probability came into play with finding venues' WVO vat full. Typically vats were emptied on a weekly cycle. Sometimes we arrived just after they had been emptied and there was nothing left, sometimes we arrived just before and they were full.

As a general rule we didn't have to ask at more than 4 restaurants before finding a significant quantity of oil which would last us to the following day.

More often we found oil at campsites and service stations where our journey took us and didn't have to detour or make extra stops to find the oil we needed.

Some venues were un-willing to let us have their waste oil because they were worried that they would face consequences for not properly accounting for their waste oil, or that they would be breaching the contract they had with their waste oil collection company. We experienced this in Italy and Croatia.

Before the rally we produced official looking Waste Transfer Notices that we offered in these circumstances and they proved very effective at persuading unwilling restaurant managers to part with their oil.

Finding oil in regions where waste management laws are not rigorously enforced was difficult because the WVO is flushed into the drain so there was no oil stored, however we found that even in these regions some restaurants did have their waste oil collected legitimately and so did have a storage vat. Northern Greece was where we noticed this situation.

Conclusions

All the teams made it to Greece without using fossil fuel. Two teams did have to resort to using fresh vegetable oil for 200km of the journey but apart from that all teams completed the journey on WVO.

No one was asked to pay for any of the WVO used, saving an average fuel bill of £350.

Collecting oil to use as fuel from the place where it becomes a waste product means there are no carbon emissions associated with its transportation.

We found that our project motivated people we met, and people who saw it in the media to try using vegetable oil as a sustainable fuel in their vehicle. Over 100 people have now pledged to try sustainable fuels through the rally website.

If waste vegetable oil is allowed to decompose, it produces methane, which is a more impactful greenhouse gas than CO₂.

The rally will now become an annual event, hopefully with increasing numbers of teams and vehicles. It's hoped that in 2009 it will also be a springboard for an even longer sustainably fuelled expedition to Asia.

With the right equipment, convincing paperwork and a level of determination it's possible for individuals, or even a large group, to cross Europe using locally sourced vegetable oil as a free and carbon neutral fuel.