

Driving further on greener fuel

Biofuel blends in KSRTC's buses in India

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As part of a raft of environmental programmes, 81 buses in the Indian city of Bangalore now run on a diesel:pongamia oil blend. As well as affording a huge cut in emissions, this fuel has enabled annual savings of over EUR 20,000.



KSRTC is a pioneer in the use of SVOs blended with diesel

Karnataka State Road Transport Corporation (KSRTC) was established in 1961 as a State Owned Roadways Transport Undertaking. The Government of India and Karnataka State Government have a stake in the capital structure of the Corporation in the form of an equity and capital contribution. KSRTC has its headquarters in Bangalore, India, and is a public utility service that aims to provide adequate, economical and properly coordinated passenger transport services to the citizens of Karnataka State.

KSRTC currently operates 5045 schedules with a fleet of 5423 buses covering **1.75 million km** and carrying about **2.3 million** passengers per day. Daily traffic revenue ranges from INR 30 to 40 million (EUR 515,000 to 687,000). KSRTC employs a workforce of 25,897 in its 10 operating divisions, which include 56 depots, two regional workshops, a printing press, three training centres and a hospital. KSRTC offers a range of passenger services using World Class Volvo AC buses, Ultra Deluxe buses, Semi deluxe and Express buses. These aerodynamically designed and fuel-efficient buses operate on regional urban and suburban routes - both local and long distance services - that can be up to 1200km in length.

Turning fortunes around

Transport is an important index of the social, cultural and economic development of any society. Although passenger transport is a business for public transport operators, it is very difficult to run under a strict business principle of *no profit and no loss* given that State transport undertakings are run as more of a social service than a business. Financial performance at KSRTC has been exceptional in spite of the need to fulfill this social responsibility obligation and its transformation into a profit making organization is unheard of in Indian State transport undertakings. Over recent years KSRTC has turned its fortunes around, starting from -480.28 million INR (EUR -8.2 million) in 1995-1996 to +327.38 INR (EUR +5.6 million) for the period 2002-2003. Its revenue margin now stands at +200.50 INR (EUR +3.4 million).

KSRTC has managed to become financially healthier by adopting new technologies and management concepts, cost control exercises and environmental upgrade programmes, initiatives that have also made it possible to maximize traffic revenue.

Combating pollution

Headed by a Director (Personnel & Environment) at corporate level, KSRTC's 'Environmental Cell' came into existence in 1996 and is the first of its kind set up by any State Transport Undertaking in the entire country. The cell monitors the envi-

ronmental impact on air pollution, water pollution, noise pollution and waste generation and has introduced various technological innovations in the areas of steam boilers, re-treading of tyres, generation of distilled water and material waste. The progress of the environmental impact assessment and implementation of environmental upgrade programmes is monitored from corporate level. Some of the pollution control measures in operation include:

- Regular pollution level checks for the entire bus fleet and display of pollution free stickers.
- Although emission levels have to be checked every six months according to regulations, corporation policy requires vehicles to be checked once a month.
- Fuel supply quality controls at all depots via random checks of fuel critical parameters.
- Ambient air quality checks at nodes such as depots, bus stations and production units to assess the impact of air pollution.
- Noise level checks at production units and depots to monitor noise pollution and keep within noise level limits - by means of acoustic treatment - at stationary generator sets.
- Cleanliness levels in bus stations, administrative offices, depots and production units, maintained through competitive grading of the depots.
- An afforestation programme launched by the organisation in 1996 in which over 278,000 saplings (pongamia and other varieties) have been planted and maintained.

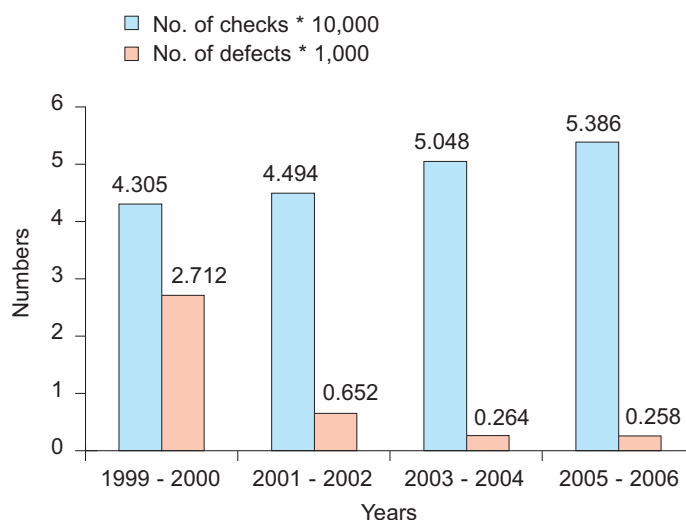
KSRTC is in the process of gaining ISO 14000 (2000) certification, and performs a monthly energy, water and waste minimization audit in all its units. On top of this, smoke emission checks have been regularly conducted on its fleet of 5423 buses.

Biofuel blend in KSRTC's buses

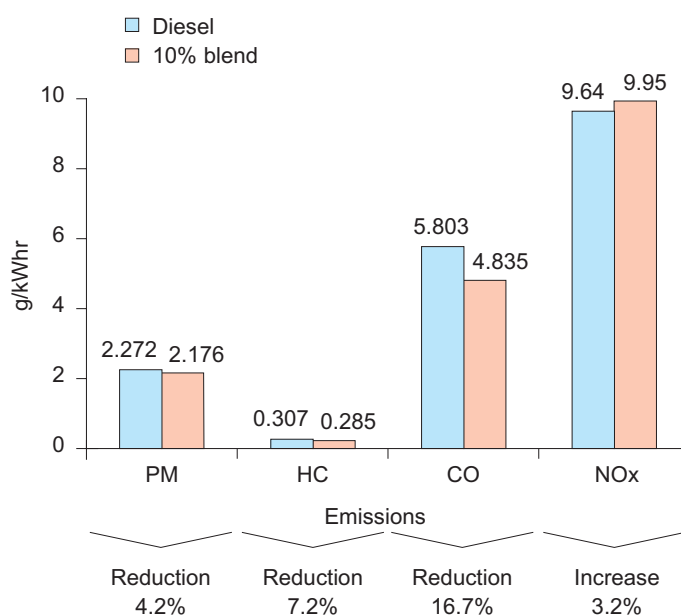
The KSRTC is a pioneer in the use of **Straight Vegetable Oils** (SVO) blended with diesel. Pongamia Oil began to be used in 2003 and at present 81 buses are in operation in KSRTC's Doddaballapur Depot using a 90:10 ratio mix of HSD (High Speed Diesel): Pongamia Oil. This split was arrived at by analysing the effect of using a biofuel / diesel blend in various ratios on a multi cylinder **Ashok Leyland Diesel Hino** engine. Induction of Pongamia Pinnata biofuel with diesel in varying proportions on an engine test bed was tested at the different speeds (varying RPM and load of the engine) and the results compared with the same engine using HSD. Significant emissions reductions were obtained especially for SO_x, PM, HC, CO and CO₂ emissions. The diesel:biofuel ratios were calculated in varying percentages of 10 and 20 with diesel. The use of biofuel with diesel in the ratio of 90:10 (Diesel:Pongamia Oil) was concluded as being the most cost effective (see overview of results below)¹ and non-polluting substance for petroleum products, and resulted in a tremendous reduction in emissions (see opposite).

During the case study in the Doddaballapur depot of KSRTC, biofuel was found to have caused no problems to fuel equipment or the engine. This was corroborated by Mico Bosch Ltd. (a fuel equipment and injectors manufacturing company in India) after dismantling the engine of KSRTC bus run on pongamia oil. The use of transesterified oil is more beneficial both for the engine and the environment. It chemically matches the quality and specification of diesel oil. However,

**RELATION BETWEEN EMISSION CHECKS
AND DEFECTS FROM 1999-00 TO 2005-06**



**COMPARISON OF EMISSIONS FOR BUSES
FUELLED BY DIESEL WITH THOSE RUNNING ON A 10% BLEND**





The biofuel was found to have caused no problems to fuel equipment or the engine during the experiment

instead of the transesterification of the oil - a useful method of reducing its high viscosity by use of a special fuel additive - a special two-stage filtration system - of 25 microns and one micron - was employed to ensure clean filtration and prevent filter clogging. To achieve better combustion and spray of the biofuel, the atomiser pressure was increased from 230 to 240 kg/cm². A 200 RPM agitator and a gear pump were also installed and operated every three hours to keep the fuel correctly mixed and steadily circulating in the underground tank.

The use of biofuel at KSRTC in the form of **Straight Vegetable Oil** (Pure Plant Oil) with an improved filter system increased fuel efficiency from 5.10 km per litre to 5.12 km per litre as compared to the buses run on HSD. KSRTC plans to gradually convert its 56 depots over to using a 10% biofuel blend depending on the operational results, the cost of biofuel and its availability. It plans to run buses on 100% esterified biofuel respecting the parameters as laid down by the **Bureau**

of Indian Standards (BIS). KSRTC has also embarked on the large scale plantation of pongamia and other varieties on plots of vacant land.

The use of biofuel and its market especially in public transport buses in India and elsewhere clearly depend upon various factors such as the production and application potential, appropriate feedstock, financial viability, environmental impact, and government and institutional support. Nevertheless, the rising cost of fossil fuel is certain to accelerate the pace of use of biofuel.

¹ A study on the use of biofuel in KSRTC was carried out jointly by BMVEL/GTZ, TERI & ISEC in October 2005 and the findings were presented at the 'International Conference And Expo - BIOFUEL 2012 - Vision to Reality' (17-18 October 2005) organized by TERI, New Delhi.

Overview of results of using 10% Pongamia Pinnata with HSD in KSRTC's Doddaballapur Depot for 81 buses

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|--|--------------------------------|
| Daily average vehicle journey | 364km |
| Average km per litre* | 5.18 |
| Cost per km on high speed diesel | INR 6.50 (11 euro cents)/km |
| Cost per km using 90/10 HSD/biofuel | INR 6.39 (11 euro cents)/km |
| Difference in cost per km using 10% pongamia oil | INR 0.11(0.1 euro cent) /km |
| Savings per bus per annum | INR 14,615 (EUR 251) |
| Approximate annual savings of 81 buses | INR 1.183 million (EUR 20,291) |

**A test study was conducted by R.V.College of Engineering, Bangalore, India (www.rvce.ac.in) for Karnataka State Road Transport Corporation (KSRTC) using 10% pongamia oil with 90% diesel fuel at their engine test rig. The results were presented at the National Conference on Biofuels, held at National Institute of Technology Karnataka, Surathkal, India, March 23-25, 2006.*

If you have questions or want information on the technical details of the trial please contact megharikh@hotmail.com / www.ksrtc.in