CHOOSING AND USING AN EFFECTIVE FLUORESCENT LEAK DETECTION SYSTEM

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With the huge increase in the number of cars incorporating air conditioning, garages everywhere are investing in equipment to repair and service a/c systems. For most of them perhaps the prime requirement is for a simple, reliable method of detecting and locating refrigerant leaks.

At present the current choice is broadly between electronic 'sniffer' leak detectors and ultraviolet (UV) fluorescent dyes. Soap solutions are sometimes used but are best avoided. Many contain chlorides which cause false alarms later if electronic leak detectors are used. They are also very time consuming.

Few would dispute that ultraviolet fluorescent (UV) leak detection provides the fastest, easiest and most accurate method of pinpointing refrigerant leaks. This paper focuses on the benefits of using such a system and highlights some of the pitfalls to be avoided.

How UV Leak Detection Works:

A small amount of fluorescent dye is added to a vehicle air conditioning system and allowed to circulate. Wherever there is a leak, the dye escapes with the system's refrigerant and remains at all leak sites. When the system is scanned with an ultraviolet or UV/blue inspection lamp, the dye fluoresces a brilliant yellow/green colour to pinpoint the exact source of the leak. Although the method is simple, it is important to carefully select dyes that are compatible with high intensity lamps (as well as with manufacturers systems) to ensure optimum results.

The most critical factors for any fluorescent leak detection system designed for use within an A/C system are not only the properties of the dye which will be introduced into the system, but the quantity of dye and the methods of its introduction.

Two families of fluorescent dyes are currently in use as leak detection tools: **perylenes**, which are patented dyes which fluoresce a brilliant yellow when illuminated with long wave ultraviolet lamps; and **naphthalimides** which fluoresce a brilliant green when exposed to UV and blue light.

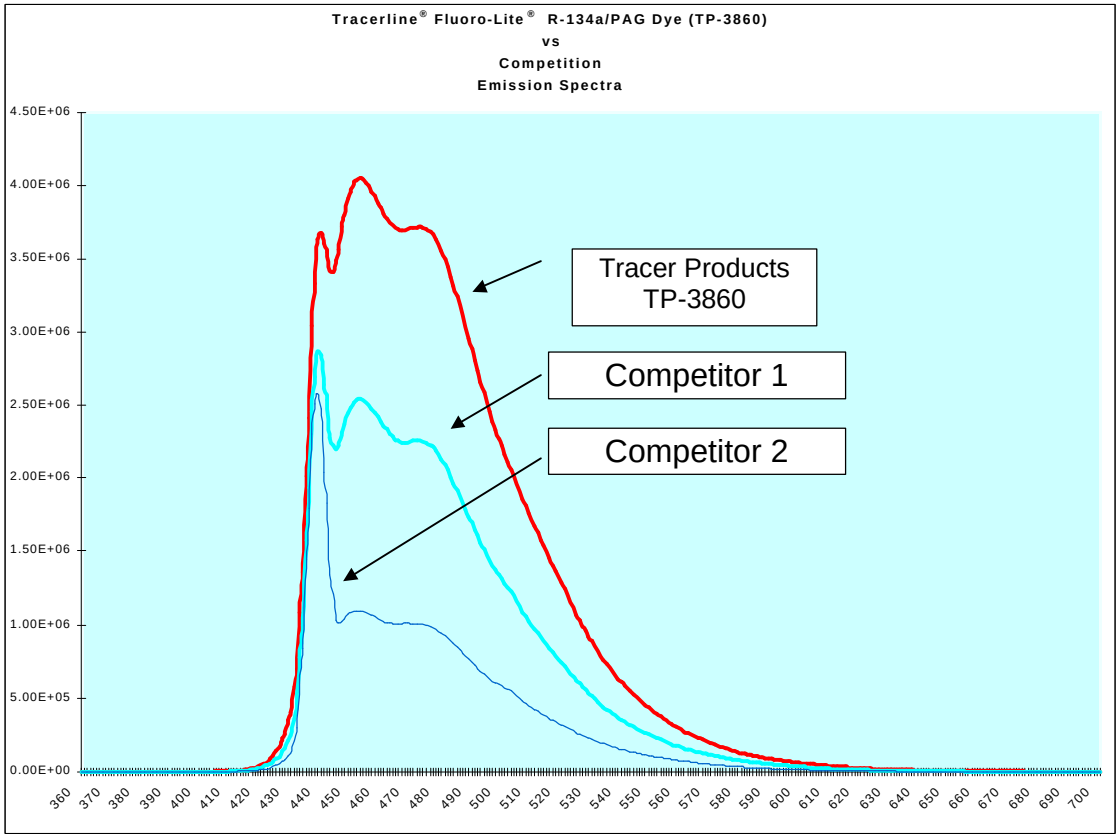

Figure 1 Not all dyes are the same.....

In either case, the dye must be soluble in lubricant and refrigerant in order to be effective in both the liquid and vapour phases of the refrigeration cycle. The fluorescent response must be strong enough to allow the final concentration of the dye within the oil to be minimal. This will ensure that any potential effects on the heat transfer properties of the system will be negligible.

Choosing the Correct Fluorescent Dye

Compressor manufacturers spend enormous amounts of time and money in researching lubricants of the correct viscosity and quality. They must be satisfied that lubricants are compatible with the

chosen refrigerant, stable at high temperature and perform well under the bonnet.

Technicians should therefore exercise extreme caution and ensure vehicle and compressor manufacturers approve the use of any particular dye before considering its use.

Universal all-purpose dyes sold for use with both R12 and R134a systems, for example, are based on polyolester oils and unlikely to ever gain approval from compressor manufacturers. A similar situation exists with dyes containing aromatic solvents. These substances reduce the viscosity of oil and therefore affect the lubricity and, more likely, the sealing function of the lubricant. They are also immiscible in R134a.

Polyolester and PAG oils are hygroscopic and, just like brake fluid, they absorb water. Esters are, in fact, derived from organic acids and alcohol and when exposed to air and moisture, a common experience in a workshop and service environment, they can hydrolyse to their acidic components and cause corrosion within the compressor. The use of bottled dyes also increases the risk of contamination with every use.

By contrast, lubricant specific, solvent free Tracerline® dyes have been specified by vehicle manufacturers for production line and aftermarket use. The prime reason for this selection and approval is that the dyes are a solution of colorant (which is a super stable UV fluorescent molecule) and high quality refrigeration grade lubricant compatible with the PAG oil within the A/C system.

The stability of the lubricant specific dye's colorant molecule plus its exceedingly low concentration in the host lubricant ensure there will be no deleterious effects to the lubricants physical or chemical properties or system components.

Best practice therefore dictates that dyes should be lubricant specific e.g. PAG for 134a and contain no aromatic solvents. The method of infusion should ensure no air, dirt, moisture or other contaminants can enter the system and minimal quantities must be used.

Introducing Dye Into the System

Earlier user dissatisfaction with fluorescent dyes has generally been due to the method of infusion. Bottles of dye, dye injectors, syringes, sachets and mixing jars have all contributed to a messy operation where dye inevitably at some time has been spilt, leaked into the toolbox or got onto someone's shirt.

For the car manufacturer the problem has been successfully solved with the introduction of the Tracerline Tracer Wafer™. A small pad of absorbent synthetic felt impregnated with a specific, optimal amount of ultraviolet fluorescent leak detection dye is placed within the desiccant of the filter dryer. The wafer retains the dye until it is released via the refrigerant and lubricant flow when the final assembly is complete. Handling of the additive is minimised. No changes to the final assembly process are needed and false leak indications are avoided.

Figure 2 The patented Tracer Wafer™ provides OEMs with the quickest and easiest way to introduce UV fluorescent refrigerant leak detection additives.

Courtesy of Spectronics Corporation

Several desiccant bag manufacturers are now equipped to automatically include a Tracer Wafer in their bags. This method provides an ideal and economical method of introducing ultraviolet fluorescent leak detection to the assembly line and is now in use by major vehicle manufacturers around the world for their production lines.

For the aftermarket a problem for the A/C equipment and vehicle manufacturer has always been to maintain the integrity of his system. Apart from the risk of contamination, bottled dyes and cartridges have traditionally infused a minimum quantity of 7.5 ml of dye.

These concerns have been resolved with the introduction of proprietary lubricant-specific and solvent-free Tracer- Stick™ capsules together with the new EZ-Ject™ multi-dose dye injection system. Both of these comply with the best practice manufacturing requirement of the minimum amount of dye and a system that avoids the possibility of contamination.

Figure 3 Tracer Stick® Capsules and connection valves

Courtesy of Spectronics Corporation

The Tracer Stick capsule contains just 1.7ml of Fluro-Lite™ for R134a systems and 0.9ml of dye for R12 systems. A single prefilled disposable capsule will treat a car air conditioning system of any size.

An EZ-Ject™ cartridge will treat up to 14 average European cars and delivers just 1.1ml per calibrated dose.

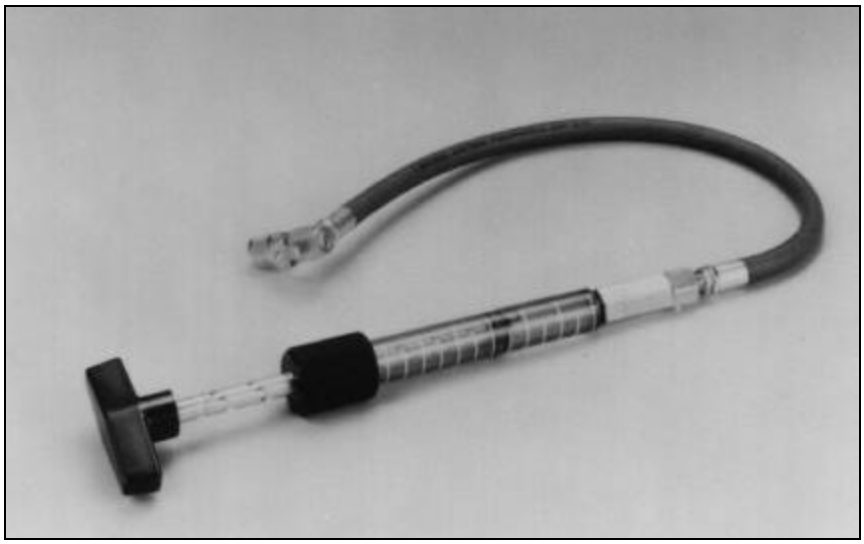

Figure 4 Tracerline® EZ-Ject™ Multi-Dose Dye Injection System

Courtesy of Spectronics Corporation

Optimising Fluorescent Response

There are presently three categories of light sources which are used to provide the incident radiation which will cause the dyed fluids to fluoresce. These are lamps which can either provide long wave ultraviolet light, visible violet and blue light or a combination of both.

High intensity discharge lamps emitting long wave ultraviolet light provide the optimal energy for use with the perylene dyes and also cause the naphthalimide dyes to fluoresce. These lamps tend to be larger than those used to provide visible light and are somewhat cumbersome where working space is tight.

Lamps which provide visible violet/blue illumination are optimally suited for use with the naphthalimide dyes, whose excitation peak lies within this range. They will also cause the perylenes to fluoresce, but only poorly. These lamps are typically less expensive than long wave ultra violet lamps and generally more compact.

Broad spectrum lamps provide substantial amounts of both visible violet and blue light as well as long wave ultraviolet light. These lamps are the most versatile as they can be used effectively with

any fluorescent dye presently on the market and can provide intense illumination even in a compact form.

New Lamp Technology

Stunning advances have recently been made with the introduction of TITAN™ broad-spectrum lamps from Tracer Products. A technique has been developed which optimises fluorescent responses of materials by employing lamp filters equipped with

Figure 5 Titan™ UV/Blue™ 12v Lamps. TP-8000 and TP-8200.

Courtesy of Spectronics Corporation

optical thin film coatings commonly known as interference filters.

These filters operate by having multiple thin films or coatings applied to a surface of the filter, thus a filter can be designed which will transmit specific wave lengths and reflect those which are undesirable. The transmission curve of this filter effectively incorporates the peak excitation wave lengths of both the perylene dye and the naphthalimide dye typically used in the industries employing fluorescent inspection. Outperforming all other lamps on the market, **Titan** lamps can be used effectively with <u>any</u> fluorescent dye whether used for air conditioning, engine, gearbox or coolant leaks.

Summary

Requiring no particular expertise, fluorescent leak detection offers significant and immediate benefits both in cost and time saving when compared with other available methods. Outlay is soon recovered through increased efficiency and there is the added advantage that the materials required are sold to the end user - something which cannot be done using other technologies.

THE TRACERLINE® ADVANTAGE

- World leader in Fluorescent Leak Detection
- Wide range of OEM approved dyes
- World's most powerful lamps
- Exceeds the requirements of SAE J2297
- Over 25 *million* systems in use worldwide
- Worldwide distribution and technical support
- Total corporate support and commitment
- OEM partnership programs

For more information on leak detection, contact

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