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RESTORE 1030

Sustainability Whitepaper
Prepared for General Reference

RAISE RESTORE1030™ (Refigerant Treatment Optimizer)
Internal HVAC/Refrigeration Solution Line

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Executive Summary and Background:

According to the OECD (Organization of Economic Cooperation and Development's most recent study regarding global energy expenditures, the current forecast indicates that global energy consumption will grow by 50% between 2010 and the year 2035 with the non-OECD country growth rate projected to be 84%. The growth engines for this dramatic increase are China, Brazil, India and the MENA (Middle East North Africa) regions. During the same period, annualized global CO2 emissions are projected to grow by 47% from 29.7 billion metric tons today to over 42 billion metric tons. Of these totals, HVAC operations account for approximately 50% of global energy consumption and 21% of the world's total CO2 emissions. These increases are being projected in spite of tens of billions of dollars invested in energy conservation measures and the build-out of alternative energy infrastructures such as nuclear, wind, geo-thermal, solar and intelligent power grids. The net result of these spiraling energy consumption projections means that in the year 2035 65% of all macro-sustainability initiatives will remain focused on **demand side reduction**.

In response to this challenge and opportunity, **RAISE** RESTORE1030™ has been proven to reduce energy consumption of A/C and refrigeration systems by an average of 15%. Positioned as a best-practice solution within an enterprise's sustainability portfolio, this technology represents a low risk and extremely cost effective solution to assist clients in optimizing their A/C and refrigeration operations and overall sustainability objectives.

RAISE RESTORE1030™ Introduction and Technology Overview:

I. Abstract:

Air conditioning and refrigeration systems have a mechanical compressor wherein, during the normal course of the refrigeration process, .05 to 8.0% of the compressor's lubricating oil is circulated throughout the system along with the refrigerant. As a result of this inherent system design, the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) have identified a phenomenon known as "oil-fouling". ASHRAE defines oil fouling as "the build-up of lubricants on the internal surfaces of the compressor wall and coils". Furthermore, recognizing that chillers are the largest energy consumers with a large market share, ASHRAE efforts in this area continue: For water chillers designed with positive displacement compressors, if oil separation is not 100% efficient, the influence of oil upon heat transfer performance and unit efficiency is typically significant. Until state-of-the-art compressor technology offering "oil-free" bearings is available in the market, heat transfer research must continue with the characterization of these oil effects. This system efficiency degradation effect is also recognized by federal resources within the National Institute of Standards and Technology Building and Fire Research Laboratory division such that funded projects are underway today in order to investigate possible advanced technology initiates to improve this system characteristic.

II. Oil-Fouling's Impact on System Performance:

Oil-fouling on the heat transfer surfaces of air-conditioning and refrigeration systems can cause a loss of about 7% of heat transfer capability during the first year of operation, 5% the second year, and 2% per ensuing year of performance life4. The fouling will continue to accumulate until equilibrium is reached between flow force and adhesion – also known as surface tension. Surface tension forces are 1 x 1039 stronger than gravity. At this point of equilibrium the accumulated oil boundary layer has achieved maximum thickness; thereby producing the greatest impediment to heat transfer efficiency. Typically, the efficiency degradation will peak somewhere between 20–30%3.

III. Conventional Methodologies to Address Oil-Fouling:

Equipment manufacturers state that migrating oil concentrations can be as low as 1%. This figure refers to 1% of the total oil volume. For discussion purposes, assume a compressor holds four quarts or 128 ounces of oil – this means that 1.28 ounces of oil is flowing through the system at any given time. Since a capillary tube, oil pressure switch, expansion valve or the entire length of the heat exchanger tubing can be fouled with a few milligrams of oil, when one percent of any oil-charge is flowing constantly through the system, the system will become oil-fouled.

A partial listing of conventional techniques to minimize the oil-fouling problem include mechanical devices such as coalescing separators, skimmers, drums, suction risers, traps or pumps. Although somewhat effective, according to ASHRAE's Handbook, these solutions are not sufficient to remove all of the unwanted oil fouling. In other words, the solutions just described will reduce the problems caused by restricted or plugged capillary tubes or stick expansion valves. They do not, however, resolve the boundary layer fouling issue.

IV. The RESTORE1030™ Solution – Technical Overview:

RESTORE1030™ ingredients have been proven to reduce A/C and refrigeration system KwH expenditures by 15% on average. The formulation technology creates several "change-benefit" efficiencies; combined deliver a valuable net result

1. The first optimization defeats the surface tension (van der Waal force) that cause the compressor's oil globules to adhere not only to each other but to the system's walls and tubing. The removal of oil-fouling restores the 20-30% loss in heat transfer capability described earlier; allowing for enhanced refrigerant contact with coils without the insulating barrier of oil bonded to coil walls. Additionally, the capillary tubes and expansion valves are also cleaned and protected from future fouling.

2. The second optimization causes the refrigerant to evaporate or "boil" at a slightly Higher temperature – typically from .05°F to 1.5°F. The cumulative effect of these 2 components

working together results in a 73% improvement in heat transfer capability; causing lower coil or vent air temperatures.

3. The third optimizing benefit is that RESTORE1030™ formulations inherently increase lubricity and boosts the compressor oil's performance. When equipment cycles off, oil drains from metal surfaces in the compressor. This layer of oil, or boundary film, between moving parts is likely to be broken. Fortunately, RESTORE1030™'s tenacious bond keeps the friction reducing properties adhered to the metal parts and is protecting these parts even when the oil is not present. With the frictional, static load of the compressor at start reduced and the operational run-time load reduced the overall amp draw required by the compressor is shaved; further enhancing electrical savings. In addition, there is less wear and tear on the equipment; extending the life of the equipment and lowering maintenance costs.

4. It is important at this juncture to differentiate RESTORE1030™ (RTO) synthetic formulation from a classification of "additives" known as PROA's (polarized refrigerant oil additives). These products have been re-marketed in various formulas and under different names for the past 25+ years. RESTORE1030™ contains no corrosive or combustible ingredients such as chlorine, sulfur, chloro-wax, solids, or formaldehyde etc. –ingredients that remove the fouling by harsh solvent action.

In contrast, RESTORE1030™ removes oil-fouling in a completely benign manner without introducing any destructive ingredients into treated systems. In fact, over the past 7+ years of performance history, there has never been one registered complaint against RESTORE1030™ from a manufacturer or end-user customer.

V. The RESTORE1030™ Solution – Commercial Considerations:

Summarized below are relevant facts that will enable interested parties to make an informed decision when considering RESTORE1030™ as a sustainability proposal for their clients or for direct installation:

1. RESTORE1030™ has been tested and successfully installed in package units (RTU's); DX split air-to-air systems, CRAC units, DX reciprocal chillers, refrigeration/freezer units, and refer fleet applications. The technology will be tested in centrifugal chillers and ammonia based systems in 2011. Installation does not require breeching the system – a nonsurgical injection method keeps the application costs to the lowest possible service expense.

2. Once treated with RESTORE1030™, air-to-air systems do not need to be treated for the duration of their performance life. For chillers, a small booster charge is recommended with the 3rd oil change after installation;

3. In nearly all cases RESTORE1030™'s payback is 2 years or less – in most instances substantially shorter. In comparison to the majority of other energy conservation solutions, RESTORE1030™ is extremely cost-effective as characterized by a smaller capital investment and significantly shorter payback. Finally, a verifiable 3 year performance history, breadth of installation experience and comprehensive nature of the product warranty confirm the low-risk properties of the RESTORE1030™ solution;

4. The dosage guideline for RESTORE1030™ is 10% - 12.5% of the system's oil volume. For larger systems there is a significant economy of scale to be derived since an "one ounce per ton of capacity" dosage ratio [which is characteristic with smaller package units] does not apply;

5. RESTORE1030™ is a 100% non-invasive installation and requires no additional hardware to be attached to the system.

6. RESTORE1030™ features a warranty of $2,000,000 per incident, for either fixed property equipment install as well as automotive/transportation installs for any component failure proven to be caused by the application of any RESTORE1030™ product. For any client to have a valid warranty in force, the following conditions apply:

   a. Installation must be performed by a licensed HVAC technician with a current license and classification for the system being treated e.g. chiller vs. package systems – this is in compliance with the EPA federal mandate for servicing this type of equipment.

   b. Technician must document that the unit is operating within the manufacturer's operating specifications and is within (8 years of age, over 8 years coverage is for 90 days) for package units and (12 years, over 12 years coverage is for 90 days) for commercial chillers;

   c. Installation sheet must be submitted to RAISE Energy for warranty registration to be valid. If the system is not registered it is not warranted.

7. RAISE Energy offers installation services that can be quoted separately. In addition, RAISE Energy will provide training to local teams or designated installation resources to facilitate a self install solution. RAISE Energy can also provide an assortment of installation tools that have been developed specifically for the installation of RESTORE1030™;

8. RAISE Energy has technical and administrative resources that are available to collaborate with corporate facilities management teams to determine the specific dosing of RTO the system being considered for treatment with RESTORE1030™ is required for optimum potential performance benefits. The total system oil volume and combined system specifics, once confirmed, will be used to calculate the proper amount of RESTORE1030™ to be installed.