Cleaning and flushing procedure

In the next pages we want to share with you some of our best knowledge and practices on cooling fluid replacements that will help you to build and maintain an efficient installation with a long service life.

1. Read this first

By now you have decided that you want to get rid of your old liquid that is causing you problems. But it is important to understand that often a fast flush and refill alone will not be sufficient. A correct replacement will help you. Yet, careful consideration on how to proceed and how to act is essential – otherwise things might get worse! One should keep in mind that replacements, with or without chemical treatment, are not without risk. The following guidelines will give a way to reduce those risks however *there are no guarantees that no problems will occur*.

Besides performing some basic checks before the actual replacement, you should follow a few but strict guidelines to reduce the risk at the day of the replacement. And finally, you should keep a proper check on the installation and the product inside once the switch has been made.

Potential reasons to change the liquid can be:

- The liquid has degraded or additives have become unstable.
  E.g. the liquid shows severely depleted silicate or phosphate levels.

- The liquid has been contaminated by aggressive chemicals.
  E.g. Chemical cleaning agents were not properly removed before filling.

- The liquid is not compatible with major engineering materials.
  E.g. A brine was used in cast iron equipment functioning most of the time above 20°C.

- The liquid performed unsatisfactory from a thermo-physical standpoint.
  E.g. A mono propylene glycol based product was used in a deep-freeze application.

- The liquid did not comply with the toxicological and/or environmental requirements.
  E.g. A mono ethylene glycol based product is used in an installation in the vicinity of food.

- The liquid is contaminated with large amounts of corrosion products and analysis shows that these amounts are increasing.

There are many reasons why simply removing the liquid itself might not be enough. Important is to recognize that the problems are often related to a design error, operational malfunction or poor maintenance of the equipment, such as:

- A galvanized piping was used.
- Corrosion has occurred because during filling a lot of air had been introduced.
- A pump is hampering because it had not been used in weeks.
- Ammonia is leaking into the heat transfer fluid.
- Etc ….

That means that not only information on the liquid, but also on the components of the system, its operating conditions and its history will be key to finding a solution.

The golden rule in problem solving is that only when looking at the system as a whole, one has the biggest chance to solve the occurring problems. Merely focusing on a part of it, seldom meets the expectations and often only has a marginal effect.

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2. What to do before the liquid is removed

Check the condition of the liquid

Contact your **Zitrec** or **Freezium** representative and have a sample of your current liquid analyzed. This is needed to have an idea of the condition of the liquid and, indirectly, also of the system. Such an analysis could show that the liquid contains a lot of corrosion product, little or no inhibitors, a high amount of aggressive ions, or is contaminated ….. .

Together with the sample, you should provide following additional info:

- Information on the supplier
- Its time in use
- Maintenance records
- A clear description of the problems
- Previous analysis reports if any

All given info will help us to give you the best diagnosis. Also, if in any way possible, inform us about other chemicals that were used in the system and their purpose. A copy of product data sheets or safety sheets can be of great help in anticipating potential problems.

Check the condition of the equipment and describe the problems you are experiencing

From several cases in the past, we could conclude that often the heat transfer fluid was not the cause of the problem, and that these problems could have been resolved quite easily had all aspects of the problem been taken into account. The cause often lies elsewhere! It is therefore a good exercise to investigate the equipments' condition and relate the problems to all possible causes. Furthermore, even if the liquid was not the ideal choice, this information will help us in our recommendations toward you.

In some cases the problem observed can be related to one single cause, like the incompatibility with one of the materials used in the system, the continuous leaking of air, the leaking of refrigerant gas, or the leaking out of liquid by improper installation or maintenance…. It is obvious that solving/reducing such problems and making the necessary repairs, will have to be done together with the liquid replacement. If clear causes can be pointed out and resolved, then there is often little reason to choose another liquid as a replacement. This can be a big advantage if your system was designed to work with one single type of liquid.

One of the strengths of the **Zitrec–Freezium** products is that they cover an exceptionally broad range of conditions. This enables us to provide you with the best technical and realistic solutions.

Gather information

We advise to check if the materials in the system and the operating conditions are in-line with what product information leaflets and other available user guidelines indicate. When in doubt or if you have any question on the choice of the best HTF for your system/application, contact your **Zitrec–Freezium** representative**.** Always consider the most severe conditions in the system (e.g. highest temperature) when making a choice. In doing that, remember that the indicated values are for properly operating systems (e.g. with minimized air intake) and designed according the correct corrosion technical requirements. When in doubt on the actual materials used in the equipment contact the company that installed or designed the equipment.

On the basis of the information provided concerning the condition of the secondary system and our analysis, a recommendation will be made

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concerning the replacement and/or maintenance of your system.

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Replacing the liquid

The current liquid should be drained from all parts of the cooling system, this by the combined action of pumps and gravity. We highly recommended that the draining is done at the lowest point of the system, to assure that as little as possible of the existing liquid remains behind. Verify also if there are locations in the installation where liquid might be accumulated and where removal by the pump was not possible (pockets, closed valves…)
In order to reduce the exposure to oxygen of the metallic, the replacement procedure should be continued as soon as possible after draining. A drained system should never be left empty or exposed to air longer than necessary. Perform the necessary maintenance, cleaning treatment, and conditioning and refilling in a continuous process.
After draining, all filters in the system should be cleaned or replaced. One might want to consider installing a filter unit in a by-pass of the pump, so that suspended matter can be removed from the system on a more frequent basis. We advise to use backwashing bypass filters or backwashing/de-aeration filters for this purpose.

Chemical Cleaning Treatments

Besides the mentioned repair or replacement of parts, corrosion and fouling can be so severe that an internal examination followed by a harsh chemical cleaning is needed. Although we can not provide you with a specific recommendation on exactly which treatment to use, some aspects about these aggressive treatments should be kept in mind :

- The chemicals used are often very efficient scale and corrosion product removers. However, they can be extremely aggressive towards various metallurgies and even sealing material. Care should be taken that the treatment is done at the right dosage, for the right time and at the right temperature. Afterwards no remnants of these chemicals are allowed in the system as many of these chemical are strongly acidic or alkaline and have excellent metal sequestering (in some cases dissolving) properties.
- Often these chemicals will remove scale and deposit that were covering up perforations in the equipment. This can lead to more leakages if the new liquid is put in unattended. This means that a visual checking for leaks or preferably a pressure test is advisable. Take the time to do the necessary repairs.
- Often these chemicals contain very effective dispersants, which is a good property to mobilize the deposit in your system. However, when not removed properly, excessive foaming will be a consequence.
- These products typically are harmful and corrosive, not only for the equipment but also for the health of its user. Make sure that adequate protection tools, as described in the product information or material safety sheet are used during the operation.
- As after the cleaning treatment, water based heat transfer fluids will be used (be it salt or glycol based), do not use products that are incompatible or insoluble in water at a neutral to slightly alkaline pH.
- Inform the cleaning company of the materials in your system. Certain cleaning agents may well work on one material but might have a disastrous effect on another one.
- The chemical cleaning agents should be removed in such a way that as little as possible remains in the system. This will reduce substantially the amount of rinsing cycles afterwards.
- Always store the product information and/or safety sheets of the chemicals used for cleaning. We advise to store about 100 ml.

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Conditioning the system

We recommend a 5-vol% dilution of **Zitrec AC** in clear neutral tap-water as a conditioner fluid. **Zitrec AC** is an inhibitor super concentrate that should be diluted with water before use. Alternatively a ready-to-use mixture **Zitrec AN** can be used.

This **Zitrec A** dilution will not only flush away remnants of the previous liquid, suspended scale and dissolved corrosion products; it has, due to its unique additive package, important advantages compared to pure water. **Zitrec A** contains a synergetic combination of OAT "organic acid technology" inhibitors offering wide corrosion protection towards various metallurgies, such as cast iron, carbon steel, stainless steels, aluminium, copper, solder, brass and bronze. **Zitrec A** dilutions do not contain scale forming or oxidizing inhibitors and are, when used in a correct dilution, considered non-harmful products. **Zitrec A** dilutions are only slightly alkaline and are not corrosive, unlike some of the above mentioned chemical cleaning treatments.

The additives in **Zitrec A** have a soft dispersive action, meaning that even when no chemical cleaning is used, **Zitrec A** will promote the removal of scale and corrosion product. This effect however is mild and in heavily contaminated or older systems the effect might be too slow to clean away all contaminants. Small amounts of diluted **Zitrec AC** can be disposed off through the water treatment system as they have only a small oxygen demand for microbiological degradation.

The recommended procedure for conditioning is the following:

- Prepare sufficient **Zitrec AC** dilution to fill the system above the fluid level at which the system normally operates. Freshly prepared **Zitrec AC** dilution should be clear and virtually non-coloured. (Some yellowish discoloration will occur over time when left exposed to light).
- Measure the pH of the fresh **Zitrec AC** dilution or **Zitrec AN**. This pH value will be a guideline to determine when rinsing can be stopped. The typical pH of fresh dilution will be around 8 to 9. Write down this value. The recommended precision of the pH-measuring equipment used should be 0.1 units, which is the common precision of laboratory pH meters. Strips can be used, however many of these will only allow for a far less precise pH measurement.
- Fill the system from it lowest point and pump the **Zitrec A** dilution around for a least 10 minutes. Allow for a low initial pump speed as in highly contaminated systems foaming may occur. Make sure that all valves are opened several times during the conditioner treatment. If different pumps are present in the system all of them should be activated, be it in sequence, during the treatment.
- Subsequently drain the liquid as much as possible from the system and measure the pH of the drained liquid. If the pH is more than 0.2 units different from the fresh solution, and/or the liquid is contaminated with suspended particles or oil drops or discoloured, the treatment must be repeated.
- The conditioning step is repeated as long as a pH difference of more than 0.2 units is measured and/or visually contamination is observed. Especially in systems treated with chemical cleaning agents, care must be taken that all cleaning agent is removed from the system. If no excessive foaming occurs, pump speeds can be increased, and series of short stop-starts can be introduced to increase the efficiency of the rinsing cycles. In highly contaminated systems, more than 5 rinsing cycles are not uncommon.
- During the subsequent conditioning steps, one should check the system at critical parts

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(valves, flanges, de-aeration points…) for leaks. Possibly a repair of parts may be needed.

- When the properties of **Zitrec A** dilution inside the system do no longer alter, a pressure test should be done on the system, or on critical parts of it, to ensure no leaking occurs. This is highly recommended, as leaks not only increase the air-intake of the system, external corrosion of the equipment can cause serious problems as well.
- Finally, the **Zitrec A** dilution should be drained to the largest possible extent, because **Zitrec A** dilutions do not offer freeze protection. **Zitrec A** remaining in the system will decrease the glycol or brine percentage of the newly introduced liquid, thereby influencing the freeze point of the total solution.
- We recommend that a 250 ml sample of the final **Zitrec A** dilution leaving the system is kept and stored in the dark for reference. Note on the label its pH, the date, the name of the installation, the name of the person(s) that did the conditioning and the number of flushing cycles. This will be very valuable for later reference.

Introducing the new liquid

The subsequent steps depend on the new liquid that will be introduced. Depending on the type of product a different approach should be followed.

After the conditioning of the system with **Zitrec A**, the system can be filled with **Zitrec M** or **Zitrec L** with just a check of the freezing point of a sample of the liquid after filling. This because the pH and additive packages are very similar. This check is needed to make sure that no large quantities of **Zitrec A** dilute the **zitrec M** or **L** introduced.

When **Zitrec F** is selected as a replacement fluid, it is highly recommended that the system is flushed at least once with the appropriate **Zitrec F** dilution. This to ensure that no important amounts of non-FDA approved chemicals remain in the refrigeration system.

When **Freezium** or **Zitrec S** is selected as a replacement fluid, both typically used for sub-zero°C applications, a procedure similar to the conditioning procedure is followed. These salt based liquids have a higher optimal operational pH range than **Zitrec A** dilutions. The approach of the pH measurements is somewhat different, because pH measurements on concentrated salt solutions are prone to erroneous results. The pH of a 10vol% dilution of the fresh **Freezium** or **Zitrec S** product is measured and compared with a 10 vol% dilution of a sample of the fluid that has circulated 10 minutes in the system. The dilution is done with clear water with a pH between 5 and 7, ideally de-ionized, de-mineralized or distilled water. If a pH difference larger than 0.2 pH units is observed, the liquid should be replaced by fresh **Freezium** or **Zitrec S**. This will however only occur when large quantities of liquid remained in the system, in which case the required freezing points could be jeopardized.

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3. What needs to be done AFTER the liquid is replaced?

After the substitution has been accomplished, the installation should be checked regularly during the first weeks. If the base fluid was altered or if large amounts of deposit have been removed, the refrigeration capacity of the installation may change to an important extent. The swelling and shrinking of sealing materials can be different in different base fluids, leading to unexpected leaking. Often a tightening of the connections will solve the problem, but if left unattended, important external corrosion could occur. It is also a good practice to clean the in-line filters of the equipment more often.

The introduction of a new liquid is also the ideal moment to start a monitoring program on the fluid of your refrigeration system. Such monitoring programs often allow for an early identification of problems, so before they reach dramatic proportions. With a good monitoring program, the control of the level of corrosion inhibitors, the water quality and the evolution of corrosion product concentrations are possible. Next to these chemical parameters, the freezing point and the pH of the liquid are obvious parameters to be checked.

The initial sample for a monitoring program is best taken around 2 to 4 weeks after the replacement. A sample of about 250 ml in a clean and dry plastic or glass bottle should be submitted for analysis (do not use metal cans). Always indicate the date of sampling and the time the system is running on the product. In order to monitor fluid parameters over time it is important that samples are taken from the same location of the equipment.

The recommended frequency of analysis is highly dependent on the history of the system. In secondary systems having a history of problems, an initial frequency of 6 months is recommended. Analysis reports are available 3 to 4 weeks after the samples arrive in the lab.

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