

Causes of hot water cylinder failures and Xstream's solution.

Introduction

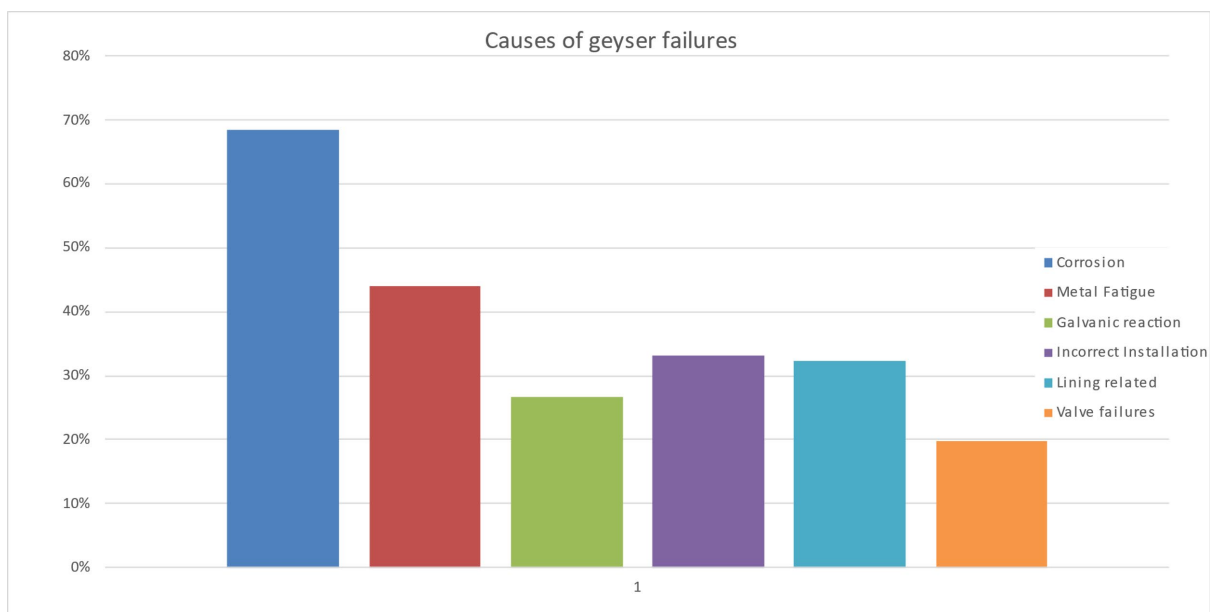
During 2003 Xstream started to manufacture pressurised hot water cylinders using non-ferrous materials in the believe that common problems associated with these (metal) tanks can be eliminated.

Almost 20 years later, and with Xstream's proven track record in the field, the plumbing community was approached again with the following questions:

1. *In your experience replacing geysers, over the past 5 years, what was the main cause of geyser failure? and*
2. *What, in your opinion is the average resultant damage cost of a geyser failure?*
(See <https://xstream.co.za/plumber-survey>).

Results

A total number of 127 responses were received, with a combined 1875 (average 14) years in the industry.



Discussion

Corrosion

- Corrosion is a destructive attack on a metal due to a chemical or electrochemical reaction with its environment.

Metal fatigue

- What is material fatigue? Definition, as found in Wikipedia:

- In materials science, fatigue is the weakening of a material caused by repeatedly applied loads. It is the progressive and localized structural damage that occurs when a material is subjected to cyclic loading.
- Relating to hot water storage tanks, expansion occurs when water is heated, pressure drops when water is used, incoming cold water causes contraction of tank, repeated over time till it breaks due to metal fatigue. The same way that a piece of 3 mm wire is cut – by repeatedly bending it up and down till it breaks.

Galvanic reaction

- Galvanic corrosion occurs when two metals with different compositions are electrically coupled in the presence of an electrolyte. The more reactive metal will experience severe corrosion while the more noble metal will be quite well protected. Perhaps the most familiar examples of this type of combination are combinations of steel and brass, or copper and steel.

Lining related

- In order to prevent corrosion on metal tanks the inner surface of geysers is coated with a layer of some anti-corrosive material, be it an enamel or glass lined coating or various types or polymer coatings.
- In order to protect any potentially bare areas exposed to the hot (more aggressive because of temperature) water inside the tank, a sacrificial anode is installed that protects these areas. As long as this anode inside the tank is in an active state there will be no corrosion and the very small uncovered areas will stay intact. Regular inspections of the anode are necessary and the lifespan of the anode depends on the “hardness” or “softness” of the water, temperatures and water usage.
- If not replaced in time, the anode becomes inactive, and the tank will start to corrode. The manufacturer’s warranty could also become null and void in this case.
- Some other types of linings might delaminate from the inner tank as different materials have different expansion rates, or the lining material is not suitable for very high temperatures.

Xstream’s positioning

- **Material selection**
 - The entire Xstream tank is manufactured in the ISO 9001 accredited factory in Paarl, South Africa using non-ferrous (no metal) material. The material selection was done based on a finite element model (FEM) with extreme operating conditions in mind. As raw materials improved over time these new material properties were analysed against this FEM and where applicable improved raw materials were introduced.
 - By opting for non-ferrous material in manufacturing Xstream eliminated the vast majority of known factors causing geyser failures – see graph.
 - Xstream tanks cannot corrode;
 - Xstream tanks are not subjected to galvanic reactions – all ports from the tank are non-metal;
 - Xstream tanks are not subjected to metal fatigue – as there is no metal present. Thermoset materials, as used by Xstream, have a proven history in handling

continuous expansions and contractions due to their flexural strength and elongation properties.

- Xstream tanks are manufactured from a single material with the same expansion properties, do not have metal present and therefore do not need any form of lining, eliminating the need for an anode and regular replacements thereof.

- **Manufacturing benchmark (SABS)**

Xstream Solar Hot Water Cylinders (Pty) Ltd is a South African Bureau of Standards (SABS) permit holder as manufacturer of hot water cylinders, regulated by SANS (South African National Standards) 10151 codes.

- These specifications are outlined in SANS 10151, par B5. The full standard is available from the SABS website.
- Over and above the standard safety and mechanical tests, Xstream tanks are also subjected to extreme accelerated destruction tests:
 - Par B5.1.1.2 Burst tests and par B5.3.3 of SANS 10151 test procedures – 3 tanks are randomly selected from the production line, heated to 75° C, all fittings blocked off, safety valve removed, connected to a pressure pump, pressure is increased with the burst pressures logged – the average of which must be 20 bar (bearing in mind that these tanks are 4 bar rated, thus a safety factor of 5 times).
 - Second set of tests - 100 hours tests where a different batch of 3 tanks are randomly selected from the production line, safety valve removed, heated and maintained at 75 °C, under pressure at 12.8 bar – the geysers must hold for minimum of 100 hours.
 - Third set of tests - 1000 hours, same as per the 100- hour test, at 75 °C and 10.8 bar – for 1000 hours – this equates to 41 days on the test bench.
- These tests describe the development of the log-log graph of the Xstream geysers which equates to an accelerated destruction test – based on an expected life span of 15 years.

- **Field test**

More than 99% of all Xstream tanks ever manufactured (cumulative since 2003) are still operational today.

The combination of material selection, SABS benchmark and attention to detail through the ISO 9001 system by dedicated and loyal staff are to be credited for this astonishing achievement.

Client testimonials

- **Eugene Reynders, On Tap Paarl**

“On Tap Paarl has been doing business with Xstream since 2003. Xstream geysers are made to last. With all the Geysers we sold of Xstream we have had not one tank failure, only the odd thermostat and element failure. The Xstream geyser is the perfect solar geyser designed for all weather and water type conditions. We have had water conditions on our farm areas and the Xstream geyser is the only geyser

that lasts. We can sell the Xstream geyser with confidence and know our clients will get excellent service from this geyser. This Geyser also have superior benefits above the other geysers in the market. I will always recommend a Xstream Geyser to a client”.

- **Michal Dabrowski, Aqua solar**

“Aquasolar has been using Xstream solar geysers in our installations for the past 6 years. Their service is always exemplary and both pre- and post-sales support is great. The Xstream geyser is a very reliable product with an almost non-existent failure rate and plenty of stock always on hand. In this fickle industry it is hugely beneficial to have a partner like Xstream that we know we can rely on. I would definitely recommend doing business with Xstream based on our long running positive experience in dealing with the company and their product”.

- **Riaan Honeyborne, ITS Heat Pumps and Solar**

“Over the past 12 years ITS has partnered with Xstream geysers for a number of reasons with regards to the procurement of domestic geysers. The brand has become synonymous to strength, longevity and high performance, something rarely seen in the current geyser market in South Africa. With their fast efficient service, you are always guaranteed the greatest quality systems at an affordable price, backed up by an unrivalled their unrivalled support structures. We will continue to use Xstream for many years to come and would like to say that if you want a geyser that will last, Xstream is the way forward! Thank you Xstream’.

Resultant damage and the Insurance Industry

In South Africa most hot water cylinders are installed inside the ceiling space.

Previous gravity fed, open to atmosphere systems (up to the 70’s) had to be installed at a point higher than the point of use in order to allow the hot water to flow down – however with closed vent (“high pressure”) tanks that have replaced the gravity fed systems over time, this is not necessary any more, yet the installation position remained in the ceiling space...

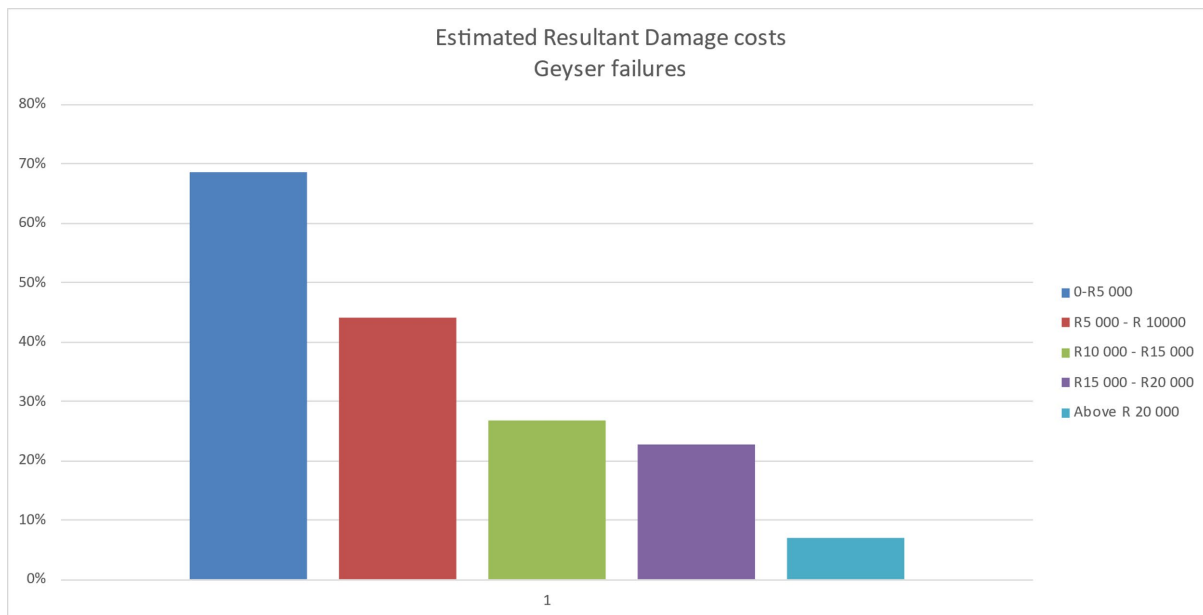
Short term (house owner) insurance covers resultant damage of geyser failures.

The following scenario plays out regularly:

Geysers, with serial number “123” is installed in the new development. Within the five-year guarantee period of geyser “123” (say in year 4) the tank develops a leak and has to be replaced. The manufacturer replaces “123” with tank number “789”, but removes serial number “789” and replaces it with the old serial number “123”. Thus, there is a remaining one-year guarantee left on “123” - the guarantee is a once off 5-year period.

Should the new tank (“789” with serial number “123”) give any problems thereafter it will be replaced by the Insurer as the guarantee has lapsed.

Any resultant damage costs are borne by the Insurer.



- **Installer category**

Albert Einstein is widely credited with saying:

“The definition of insanity is doing the same thing over and over again, but expecting different results”

If this is made applicable to the hot water cylinder industry it can be described as replacing a (corroded/galvanic damaged/lining problematic/metal fatigued) tank with a similar unit and expecting a different outcome (new geyser, despite having the same properties as the one replaced, will somehow not have the same problems).

Various categories of plumbers operate in the market place – some specialise in contract work, other in maintenance etc.

There is however another category – those that specialise in insurance (replacement) work. This category of plumbers relies on hot water cylinder failures to earn their livelihood.

Various companies specialise in rendering a service administrating claims on behalf of the Insurer. Certain preferential service and supply agreements are maintained on behalf of the Insurer, prescribing products and pricing. Unfortunately, Xstream was unsuccessful, thus far, to be included as part of these panels.

This category of plumber, in general does not support the long lasting Xstream product, for obvious reasons, HOWEVER quite often you’ll find an Xstream tank installed in his/her own home, or that of a family member.

- **Product options**

If you want different results from those you are getting, you have to find a different (non-ferrous Xstream) tank - that cannot corrode, does not have galvanic reactions, does not have a lining that can delaminate nor is it subject to (metal) fatigue.

The choice of product in replacing the failed unit currently lies with the Insurer – as pointed out at preferential rates etc., yet the homeowner still has a choice. A growing trend experienced by Xstream is where the homeowner is making the choice of another product (preferring Xstream's non-ferrous range) in order to expect a different outcome. The homeowner then simply pays the difference in price.

- **Insurance premium**

The Insurance Industry in general is experiencing limited “goodwill” – resulting in a high volume of policy cancellations and renewals. Although verified data is limited it is safe to say that the average short-term policy does not exceed 3 years with the same Insurer.

In practice this means that no Insurer will benefit from opting for a longer lasting product (read “Xstream”) because the Insured will move along to another Insurer and the next Insurer will then benefit. Perhaps this partly explains the reason why Xstream is not part of the suppliers to the Insurance Industry.

Xstream therefore currently explores the market to sell their tanks with a fully paid-up Insurance policy, covering all warranty related costs – this will then enable the Insured to approach the Insurer to exclude the geyser from the Home Owners Policy and allow for freedom of choice by the Insured.

Summary

- Hot water cylinders undisputedly fail over time.
- Xstream has eliminated the main causes for such failures based on their material selection and manufacturing standards proven over time since 2003.
- Xstream geysers are a long lasting, value for money option with a proven track record based on scientific evidence as presented herein.

D. Thirion

MD Xstream Solar Hot Water Cylinders (Pty) Ltd.