Vapac Information

Over Current

Over current will occur when the cylinder produces an extremely high peak current over a short time period, this can be up to 200% of its full load current
The normal reasons for this are cylinder efficiency reduction leading to an extended time period for the water to be concentrated, which may lead to foaming. The foaming action would then reduce the operating water level and create a high current density within a small part of the electrode.

Negative Pressure

Negative pressure will cause problems with the unit drainage because suction within the cylinder will work against the pump impeller and cause it to cavitate. This can lead to pumps overheating and bottle electrodes being burnt away because of over concentration.

Foaming

Foaming can be caused by the following:-

Contaminated water
Chlorination chemicals
Flux from copper soldiered connections

Over concentrated water
Wrong type of cylinder for the water
Insulated electrodes
Poor drainage
Low water pressure

Other Faults

Kinked or trapped steam hoses, creating a back pressure.
Faulty contactor coil or fuses blown on a slave circuit within a twin cylinder unit.
High positive duct pressure not allowing water to fill into the cylinder.
Electrodes wired incorrectly on a single phase power supply which in turn will cause overfilling
Level sense pin inside cylinder insulated with scale.
Low conductivity water in cylinder.

Blown fuses (External)

External fuses blowing may be caused by the following:-
Incorrect fuse size or type
Faulty current transformer not reading the current in the cylinder
Faulty analogue to digital converter on the PCB
Burnt out cylinder with excessive electrode wear causing an over concentration of minerals.
Broken mesh on electrode rod causing dead short with another electrode.
Residual circuit breaker fitted on the supply to the Vapac and either water leaking from the cylinder to the drip tray or excessive foaming from the cylinder causing a current flow to track to the copper steam pipe run.

Blown Fuses (Internal)

To ascertain if a component is failing over a given period the impedance of the component should be checked this should be within 3% of the following table

Part	Part number	Impedance	Current flow	Voltage	In rush current
Feed Valve	2620320	60 ohms	0.24	24	0.3
Feed Valve	2620325	60 ohms	0.24	24	0.3
Feed Valve	2620300	60 ohms	0.24	240	0.3
Contactor	1060506 BF50	1.5 ohms	0.93	24	7.9
Contactor	1060503 DPBF32	3.5 ohms	0.7	24	3.6
Contactor	1060502 DPBF25	4.5 ohms	0.5	24	2.9
Contactor	1060501 DPBF20	4.5 ohms	0.5	24	2.9
Contactor	1060499 DPBF9	4.5 ohms	0.5	24	2.9
Pump	2600061 50Hz	15 ohms	0.93	24	1.2
Pump	2600060 50Hz	1.15 ohms	0.1	240	0.3
Pump	2600070 50Hz	200 ohms	0.18	230	0.5
Pump	2600040 50Hz	0.9 ohms	4.1	24	7.1
Pump	2600041 50Hz	105 ohms	0.25	240	6.0
Heater	1097007 3.8Kw	13.6 ohms	16.7	230	N/A
Heater	1097008 2.5Kw	20 ohms	10.86	230	N/A

All readings are subject to the tolerance of the multi-meter used

Cylinder problems

Silica
Silica is a mineral when boiled will form into a solid which attracts itself to the standard mesh electrode, this acts as a good insulator and therefore reduces the efficiency of the electrode over a short period of time.
The signs that silica is present are a thin brown film across the electrodes or shiny brown flakes of particles similar to sand.
The options available to help overcome silica are Stainless steel electrodes or silica charcoal filters.

Softened Water
Treated water can cause problems because it will remove all temporary hardness such as calcium and replace it with sodium, if large amounts of sodium are present the conductivity will increase and create a low immersion depth on the electrodes. This low depth will lead to a high current density within a small area of electrode causing arcing and removal of the zinc rust protection coating.

Bore hole water
High amounts of temporary hardness such as calcium can be present in bore hole water, this can result in the cylinder electrodes being coated and also the bottom of the cylinder filling with deposits (this can prevent water entering and leaving the cylinder.
In extreme conditions the filter may become blocked and prevent water from leaving the cylinder, as a result over concentration may occur leading to arcing.
To reduce the effects the it may help to increase maintenance, periodically drain the cylinder or blend the supply with raw mains water.

Sizing
If the unit is undersized for the application it will continually be running at 100% demand, especially in winter months. Therefore the maximum amount of litres of water will be boiled per hour leading to more solids forming on the electrodes.

Water Feed
The water supply for all units will require water pressure from 1-8 bar (12 to 112 psi)

Output	Flow Rate litres per min
4/5 Kg	1.2 l/m
8/9 Kg	1.2 l/m
15/18 Kg	1.2 l/m
30 Kg	2.5 l/m
40/45 Kg	2.5 l/m
60 Kg	2.5 l/m
80/90 Kg	5.0 l/m

Water Hardness
Water hardness indicates the amount of mineral content of the water. The mineral content can be made up from numerous chemical elements which vary from area to area.
Some minerals such as potassium and sodium when boiled will not solidify into scale, but will remain in the water as a soluble mineral which will effect the conductivity of the water.
Minerals such as calcium will form solids and attach themselves to the mesh electrodes causing them to coat or insulate over a period of time.

Water Quality
The range of conductivity of which the electrode boiler will operate is 80-1000uS/cm
The range of hardness of which the electrode boiler will operate is 50-500PPM or mg/L

Cylinder Selection
For each size of unit there is low, normal and high conductivity cylinder to suit

Commissioning

Water feed
Ensure that an in – line strainer is fitted with the water supply to prevent any problems with the supply solenoid (from dirt in the water supply)
Note if the water supply is from a source other than main supply (problems may be diagnosed easier later with this information)
Make a note of the water supply pressure & check it is correct according to the above chart.
Flush out the water supply to remove any Chlorination chemicals and flux from soldered fittings which may cause the unit to foam.

Drain checks
Check the material of the drain, if it is plastic check that it is rated for temperatures above 100°C or the plastic will bend and cause traps within the drain line.
Ensure that the underside drain connection is at least 35mm in diameter to allow for easy connection to the drain spigot.
Check that when multiple units are connected the drain header is at least 54mm.

Unit Operation
Run the unit with the external controls or the full output override
When the unit is operating check the following: -
Manual drain operation.
Unit is feeding water through the tundish.
Check for leaks on all connections for the drain and water supply.

When water comes into contact with the electrodes ensure that the cylinder current is being maintained to the correct value.
Run the unit sufficiently long enough to allow steam to be distributed into the duct & check that there is no absorption problems (Ensure the supply fans are fully operational while commissioning).

Statement by VAPAC

Vapac Cylinder Life

Vapac Humidity Control Ltd

One of the questions most often asked by end users and one of the most difficult to answer is "How long is the cylinder supposed to last?" and they normally talk in months not years or hours.

Users readily appreciate, however, that cylinder life is dependent upon the hours run but the influence of the hardness of the water supply, the level of output required as determined by the air conditioning control system, and even the design of the system are not so clear and are considered briefly below.

Time clock operation, if any, the application including the control settings, the design of the air conditioning system, its geographical location and the severity of the winter all have a bearing on the life of a cylinder.

The number of hours in a year is = to 365 x 24 = 8760 (leap year exc.) but the actual hours that the humidifier will be required to operate will normally be less than that.

Using a time clock
If a time clock is in use then the hours per day and the days per week settings will clearly reduce the available run time. For an 8h working day the plant would normally be available for say 10h a day and 5 days a week. For this usage the available time would be: -

52 x 5 x 10 = 2600h

which is about 30% of the hours in a year.

Type of applications
If the application is for comfort then the humidifier should not be needed during the summer months and so the hours per year would be further reduced by about half to 1300h. Specialist applications on the other hand require 100% availability and often a higher value of relative humidity than do comfort systems.

System Design
Modern air conditioning systems tend to be energy efficient but older ones are not so and an old dew point system would need make up humidity in addition to the normal losses. The percent relative humidity required in the space will also affect the level of output and the hours run.

Geographical Aspect
The geographical location of the unit is also a factor as the severity of the winter will have a major effect on the life of the cylinder because of the high demand level from the control system.

Guide to the hours run per year
Consider the requirement for availability. This is system dependent. Given the hours per year is 100% = 8760h then the following could apply.

Specialist applications:
100% on time with varying demand = 8760h

Old comfort systems based on the above example of time clock operation 30% on time with varying demand = approximately 2600h / year

Modern comfort systems based on the above example of time clock operation, 15 to 20% of the time and with varying demand = approximately 1300 to 1800h / year

The effect of hardness
Having established the approximate running time per year the actual life of the cylinder is dependent upon the hardness of the water. Bear in mind that in order to produce steam the water is continuously evaporated, leaving behind scale deposits in the cylinder. The amount of scale deposits (precipitation of minerals) collected in the cylinder will depend upon the calcium content in the feed water, the carbonate factor, the stream output, the hours run and a drainage factor.

Amount of deposits
So for every 40mg/l of calcium in the feed water, a carbonate factor (cf) of 2.5, an output of 1 kg/h of steam with a drainage factor (df) of 1.2 the rate of 'precipitation of minerals' per hour would be: -

$$\frac{40(\text{mg/l}) \times 2.5(\text{cf}) \times 1(\text{kg/h}) \times 1.2(\text{cf})}{1,000,000}$$

A years operation with a 100% use (based on the above hours run examples) for soft water at 100mg/f of a unit capacity 60kg/h operating on average at 50% demand level the deposit would be: -

$$0.00012 \times 8760 \times 60 / 2 = 31.536\text{kg}$$

If the feed water had a hardness of 200mg/l then the deposit would be 5 times this: -

$$31.5 \times 5 = 157.58\text{kg}$$

Cylinder Capacity
The cylinder of a 60 kg/h unit holds up to 40 litres of water. On the 'rule of thumb basis' that the maximum weight of deposit equals the water capacity of the cylinder then the very maximum deposit would be 40kg. This being the case the above example of a specialist application would represent a probable cylinder usage per year of between 2 and 9 depending upon the hardness of the feed water. A comfort system would be considerably less but w would recommend that cylinders be changed at least once a year.

The approximate water capacity of the Vapac cylinders:

Cylinder Size	Maximum kg/h	Litres
1	4	3
1/2	5	4
2	9	5
3	18	8
4	45	20
5	60	40

In view of the above it will be appreciated that it would be impractical to make definitive statements as the above calculations are, by their very nature, approximate and they are intended as a guide to improve the understanding of the reasons for variations in cylinder life. Other factors such as the nature of the scale and the type of cylinder in use will further influence the service life of a cylinder.

It should be noted that because that nature of the water supplied to a particular site can vary from time to time comparisons of cylinder life for like periods can be invalid.

No criticism of the quality of the water supply is implied or intended.

Ref: DF4KB

Statement by VAPAC

Vapac Series 2, 3, 4, 5 and Treated Water

Vapac Humidity Control Ltd

Treated (totally softened) water accelerates the concentration of the cylinder water at a rate that prevents the Vapac conductivity management system from working and so is not recommended for use with Vapac Electrode Boilers. The explanation for this is set out below.

The operating difficulties

The operating difficulties of all electrode boilers are associated with an excessive concentration of the cylinder water.

As a result of excessive concentration the electrical conductivity of the cylinder water reaches a high value (low resistance), and the electrode immersion depth becomes shallow. This progressively reducing electrode immersion depth causes the rated current to flow from a reducing electrode area resulting in erosion.

The small metal particles resulting from the erosion of the electrodes are attracted to the magnetic pump rotor and eventually prevent it from turning its impeller. Failure of the pump to remove water from the cylinder will be detected but only after the pump has been called for.

The nature of treated water causes the system to reduce or even not make a ‘drain request’ and the pump could be jammed by iron particles without ever being required to run in. This of course would mean that the cylinder water would reach a high value of concentration in a short time.

What happens in practise

Suppose that a Vapac is set to work with a new cylinder supplied with Totally Softened Water.

Water will be fed into the cylinder until either the current value of 100% is reached or contact with the cylinder full pin is made.

As the boiler steams the conductivity of the residual water will rapidly increase so that instead of the current reducing (as would be the case with ‘raw’ water) it will remain at a sufficiently high value i.e. above 90%, to prevent fresh water feeding into the cylinder.

During this ‘no feed boiling’ the water level will go down to a point where the percentage current will reduce to a value below 90% when a feed will occur because of the shallow immersion depth.

Water fed into the cylinder will raise the now excessively concentrated water enabling the 100% current value to be reached quickly. As the fresh water mixes with the concentrated water the current will again remain high despite the reducing immersion depth of the electrodes.

This process progressively reduces the water level and increases the waters conductivity.

It is this, that creates the conditions for premature cylinder failure.

It is necessary, therefore, to prevent the cylinder water conductivity from reaching a high value.

Service Action

Action to take would be to blend the treated water with raw water to enable the Vapac conductivity management system to work. It is important to ensure that the water treatment plant provides the proper blend of water on a continuous basis.