

CHLORGEN THREETUBE SAFETY CTE

A revolutionary improvement to conventional Concentric Tubular Electrolysers

Now Concentric Tubular Electrolysers are electrically insulated
for increased Health & Safety
There are also many other unique advantages

An invention by CHLOR GENERATORS LTD (United Kingdom)

The first customer to benefit from the **CHLORGEN THREETUBE SAFETY CTE** is
QATAR PETROLEUM for one of their offshore platforms



IMPORTANT NOTICE

The Intellectual Property Rights to the "CHLORGEN THREETUBE SAFETY CTE" are protected by international patent applications and are owned by CHLOR GENERATORS LTD

INTRODUCTION

The technology used to convert seawater into sodium hypochlorite (“hypo”) by means of electrolysis is called “on-site electrochlorination”. Hypo generated this way is by far the most popular and safest chlorination method used by industry for the protection of cooling water systems and processing plants against micro and macro marine biological fouling. Typical applications are at: offshore platforms, oil & gas refineries, power stations, desalination plants, etc

There are two types of electrolyzers used in on-site electrochlorination, each with its own specific characteristics:

- CTE’s (concentric tubular electrolyzers), and,
- PPE’s (parallel plate electrolyzers)

In most cases, CTE’s or PPE’s are used in multiples of two, three or four. This is for contingency reasons. If so, then each CTE or PPE is rather referred to as a “module” whereas the total combination is referred to as an “assembly”

This information sheet is about CTE’s only

All CTE’s are constructed of two concentric mounted titanium tubes called “inner” and “outer” tubes. These are the electrodes (anodes & cathodes) and are always operated between 70 ~ 100 VoltsDC

The outer tubes of conventional CTE’s are always fully exposed. This is an inherent design dilemma of conventional CTE’s which create many problems. Some are serious, for example: the electrically uninsulated outer tubes expose operators to unsafe high voltages. See PHOTO 1 below of a typical conventional CTE module

All these problems have now been resolved with the invention of the CHLORGEN THREETUBE SAFETY CTE. See PHOTO 2 below of a typical CHLORGEN THREETUBE SAFETY CTE module

GIVEN PROBLEMS WITH CONVENTIONAL CTE’s

The main problems with conventional CTE’s are:

- **HEALTH & SAFETY concerns: Exposure of operators to unsafe high voltages**
- **External mounting frameworks take up too much essential installation space**
- **Electrical enclosures take up too much essential installation space**
- **Complications with access for maintenance**
- **Disruption of hypo generation during maintenance means no continuous protection against marine biological fouling**
- **HEALTH & SAFETY concerns: Exposure of operators and surrounding equipment to “hypo spray”**

INTRODUCTION : The CHLORGEN THREETUBE SAFETY CTE

The CHLORGEN THREETUBE SAFETY CTE was developed by CHLOR GENERATORS LTD to resolve all the above problems experienced with conventional CTE’s. The CHLORGEN THREETUBE SAFETY CTE, mainly for Health & Safety reasons, is expected to become the future replacement of all conventional CTE’s

The CHLORGEN THREETUBE SAFETY CTE is basically a conventional CTE with exactly the same operational and performance characteristics. The only difference is that it is mounted inside an electrically insulated “third” outer PVC tube/casing, hence the name “THREETUBE SAFETY CTE”. This PVC tube/casing holds all the inner and outer titanium tubes in position and forms part of the pressurized hydraulic system

Similar to conventional CTE’s, direct connections on the outer titanium tubes are necessary for DC terminals and interconnecting DC bus bars. With the CHLORGEN THREETUBE SAFETY CTE this is achieved by means of

special watertight “flanged windows” in the “third” outer PVC tube/casing. See PHOTO 3 below for typical WATERTIGHT FLANGED WINDOWS

CHLORGEN THREETUBE SAFETY CTE’s resolve the following problems:

- **HEALTH & SAFETY concerns: Exposure of operators to unsafe high voltages**

With conventional CTE’s, operators are exposed to unsafe high voltages which range between 70 ~ 100 VoltsDC. This should also be viewed against BSI publication PD 6519 which states that a dangerous voltage is when 50V is exceeded in dry conditions. This unsafe situation is further aggravated because all CTE’s are always operated in potentially damp environments, and, are prone to seawater leakages. Both seawater and hypo, due to their high saline content, are much better conductors of electricity than fresh water

PROBLEM RESOLVED : This is because CHLORGEN THREETUBE SAFETY CTE’s are completely electrically insulated by means of the “third” outer PVC tube/casing and operators no longer exposed to these unsafe high voltages

- **External mounting frameworks take up too much essential installation space**

Each conventional CTE requires an external mounting framework to hold it together. This metal framework must be comprehensive to secure all the relevant components and should also be strong enough to cope with the extreme hydraulic pressures generated in the CTE in order to prevent it from “bursting” open. A mounting framework can easily double the total space/volume of a conventional CTE module, which is the reason why conventional CTE’s are always fairly spacious and lacks compactness. This can be a big problem for installation areas with extreme space limitations, e.g. offshore platforms. (Please note, the typical conventional CTE in PHOTO 1 does not show its external mounting framework)

PROBLEM RESOLVED : This is because CHLORGEN THREETUBE SAFETY CTE’s don’t need any external mounting frames. The “third” outer PVC tube/casing is already holding it together and is designed to cope with the said hydraulic pressures. Please note, PHOTO 2 shows a complete CHLORGEN THREETUBE SAFETY CTE and no external mounting framework is required. This is by far the most compact design of a CTE

- **Electrical enclosures take up too much essential installation space**

It is always necessary to mount conventional CTE’s, including their respective external mounting frameworks, inside electrical enclosures. Usually each CTE module in its own individual enclosure. This is necessary for electrical insulation (for the protection of operators against unsafe high voltages), and, for the protection of exposed outer tubes, DC terminals and interconnecting DC bus bars against external mechanical damage. Electrical enclosures can take up unnecessary space, especially if there are multiple CTE modules, each with its own enclosure. This can be a big problem for installation areas with extreme space limitations, e.g. offshore platforms

PROBLEM RESOLVED : With CHLORGEN THREETUBE SAFETY CTE’s the use of electrical enclosures are no longer a necessity, rather an option. This is because the “third” outer PVC tube/casing already insulates it electrically completely and also offers substantial protection against external mechanical damage. However, if the end-user still demands the use of electrical enclosures, then any quantity of CHLORGEN THREETUBE SAFETY CTE’s can easily be mounted inside a single electrical enclosure. The individual CTE’s can also be stacked against each other without any gap between the CTE’s. This has a dramatic reduction of installation space required when compared to conventional CTE’s

- **Complications with access for maintenance**

Access for maintenance on conventional CTE’s is only possible “from-the-side”. Therefore, if there are two CTE modules in their individual electrical enclosures, then each enclosure should be able to open fully from at least one side. However, if there are more than two CTE’s, thus more than two electrical enclosures, then access for maintenance is only possible to the two outside enclosures but not the other “in-between” enclosures.

Alternatively, if it is decided to mount multiple conventional CTE's in a single electrical enclosure to avoid the above spatial dilemma, then access for maintenance will still only be possible on the two outside CTE's but not the other "in-between" CTE's

PROBLEM RESOLVED : This is because with CHLORGEN THREETUBE SAFETY CTE's maintenance is easily done only via the "opposite far ends". This is not affected regardless of the quantity of CTE modules stacked tightly next to each other inside the same electrical enclosure. It is also equally easy to remove or to replace a complete CHLORGEN THREETUBE SAFETY CTE module by simply sliding it in or out from any of the far ends

- **Disruption of hypo generation during maintenance means no continuous protection against marine biological fouling**

If it is decided to mount multiple conventional CTE modules in a single electrical enclosure to avoid the above spatial dilemma, then maintenance on a specific CTE is only possible if all the CTE's are electrically switched off, even if they don't need maintenance. This is vital to protect operators against exposure to unsafe high voltages. But this also means that no hypo generation can take place, thus no essential protection is possible against marine biological fouling. This can have extreme consequences with irreversible damage to the end-user's cooling water system or processing plant

PROBLEM RESOLVED : This is because with CHLORGEN THREETUBE SAFETY CTE's, maintenance can be undertaken on any random individual CTE module, whether inside or outside an electrical enclosure, whilst all the other CTE's can remain fully operational, without exposing operators to unsafe high voltages. Thus, hypo can be generated continuously during maintenance, without any interruption or disruption, in order to ensure continuous protection of the end-user's cooling water system or processing plant against marine biological fouling

- **HEALTH & SAFETY concerns: Exposure of operators and surrounding equipment to "hypo spray"**

All conventional CTE's are prone to "hypo spray". This happens when outer titanium tubes suffer punctures caused by "electro pitting". This is mainly caused by incorrect maintenance and operational procedures and can have extreme consequences, for example:

- if the CTE is mounted inside an electrical enclosure, it will get filled and pressurized by leaking hypo and hydrogen gas. If the electrical enclosure is airtight and reinforced (e.g. ATEX enclosures for Zone 1 or 2), it will soon "erupt" open because it won't be able to cope with the hydraulic pressure, or,
- if the CTE is not mounted inside an electrical enclosure (or the CTE exposed after the electrical enclosure was erupted open) operators and surrounding equipment can get exposed to hypo spray, an aggressive oxidising chemical

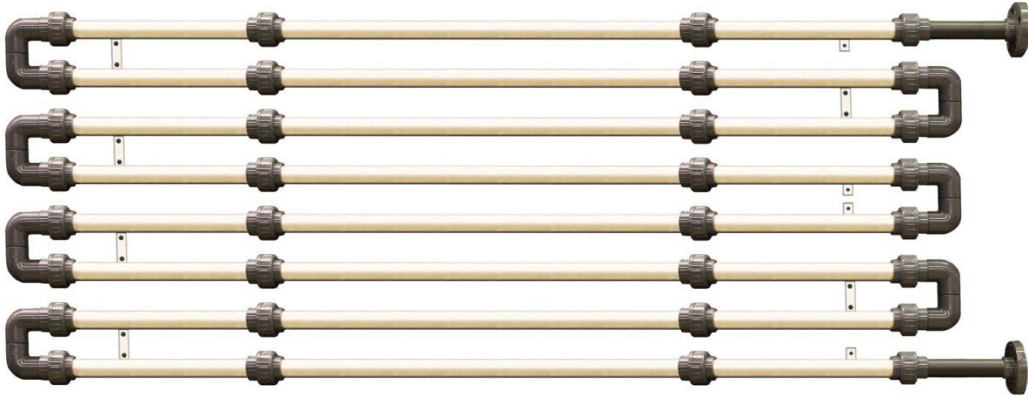
It should also be noted that CTE's are always operated at fairly high hydraulic pressures which can range between 4 to 6 Barg, therefore hypo spray can be violent

PROBLEM RESOLVED : This is because CHLORGEN THREETUBE SAFETY CTE's are mounted inside a watertight and mechanical protective "third" outer PVC tube/casing. Any punctures which may happen in the outer titanium tube will remain contained and sealed inside the "third" PVC tube/casing

NOTE: All CHLORGEN THREETUBE SAFETY CTE's are hydraulically tested for leaks at minimum 10 Barg over 48 hours

The above are revolutionary improvements to conventional CTE's and CHLOR GENERATORS LTD is convinced that the CHLORGEN THREETUBE SAFETY CTE will become the industry standard for all future CTE's

PHOTO 1 : A typical CONVENTIONAL CTE



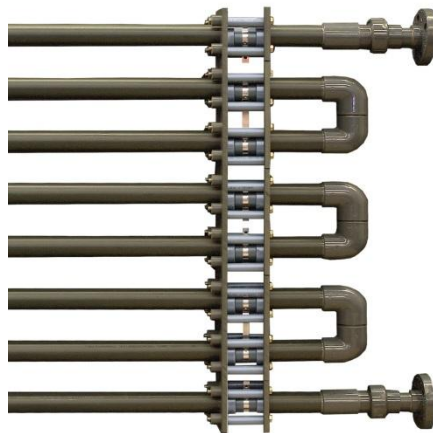
NOTE: All the outer titanium tubes, DC terminals and interlinking DC bus bars, are electrically uninsulated and fully exposed. All are also vulnerable to external mechanical damage. (The external mounting frame not shown)

PHOTO 2 : A typical CHLORGEN THREETUBE SAFETY CTE



NOTE: All the outer titanium tubes, DC terminals and interlinking DC bus bars are electrically insulated. The "third" outside PVC tube/casing also offers substantial protection against external mechanical damage

PHOTO 3 : WATER TIGHT "FLANGED WINDOWS"



NOTE: The photo shows the CHLORGEN THREETUBE SAFETY CTE with terminal covers removed. All the DC terminals and interlinking DC bus bars, when compared to conventional CTE's, are in principle the same. However, these will all be electrically insulated when the terminal covers are returned

CHLORGEN THREETUBE SAFETY CTE's are available in:

- uPVC or cPVC material (other options also available on request)
- very small to very large Cl₂ output capacities
- Safe Area or ATEX certified for Hazardous Area Zone 1 or Zone 2
- or any bespoke design if so required by the end-user because all our CTE's are designed & built in-house

ALSO AVAILABLE

Chlor Generators Ltd is a specialist designer and manufacturer of:

- Parallel plate electrolyzers for seawater (conventional single polarity: mono-polar or bi-polar)
- Parallel plate electrolyzers for seawater (reverse polarity auto self-cleaning)
- Parallel plate electrolyzers for artificial brine (conventional single polarity: mono-polar or bi-polar)
- Concentric tubular electrolyzers for seawater (conventional single polarity, bi-polar)
- Concentric tubular electrolyzers for seawater ("CHLORGEN THREETUBE SAFETY CTE")

For more information about the
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