

1. In Out-of-Service tanks, where you are applying Corrologic Powder through injection ports in the tank floor – what is the effective period of the initial application of the Corrologic Powder. We realise that the ER Probes will chart the corrosion rate, so both CME and your client will know that remedial action is required. However, after the initial Out-of-Service application, the tank is likely to go back into service for potentially 10 years – are we saying that the Corrologic Powder is capable of protecting the tank for this length of time, or is it extending the floor life by 2-3 years before the tank is treated as an In-Service application where you would revisit the tank and apply the Corrologic Slurry through access ports and pipework through the ring wall. In other words, is Out-of-Service application designed to give the client a longer floor life by 2-3 years?

CorroLogic AST solutions are designed to last for 10 years from date of application, if proper enclosure is maintained throughout this period. They are designed to slow down soil-side corrosion rate on tank bottoms, which translates to extension in service life of tank floor. Lab tests and field applications have shown that CorroLogic Powder can reduce corrosion rate on ER probes by a percentage between 80% and 95% in absence or presence of cathodic protection. We have field data where soil side corrosion rate from ER probes were kept below 1 mpy for about four years so far. Since ER probes are made of similar metallurgy and located in the same environment as the bottom plates, CorroLogic Powder is expected to reduce corrosion rate by a comparable percentage on the bottom plates. Therefore, CorroLogic AST should extend the service life of tank floor and can be theoretically calculated based on corrosion rate from ER probe. Now, whether this can be generalized on all locations on tank bottom plates is a difficult question to answer. This question becomes even harder to answer when you apply CorroLogic Powder out of service for an existing tank with old tank floor and even more difficult when you do it online when you don't have any information about the current status of the tank floor. Where corrosion in some location have developed to the extent that it might leak tomorrow. Therefore, it is recommended to talk about protection over a period rather and absolute service life extension value.

2. We have been asked by potential clients “how long will the Corrologic Powder be effective for when applied in an Out-of-Service application”. We realize that this will be variable depending on the condition of the floor at the time of application, however how do you answer this when asked by a customer. Same question goes for the In-Service and New Build application. I think this is the same question as above.

Corrologic AST solutions are designed to provide 10 years protection. System performance is monitored using corrosion probes that allow for remedial actions when required, like any other engineered system. Example is CP where they monitor its performance over its design life using potential instant off measurements and take corrective actions when necessary.

3. Would it not be better in an Out-of-Service application to go straight to applying Corrologic Slurry by drilling below the floor and inserting the application

pipework. This way you have got a method to top-up with inhibitor once you see corrosion rates increasing.

CorroLogic powder injection when possible is preferred. This method keeps the VpCI molecules very close to bottom plates and eliminates the process of VpCI molecules to diffuse through the sand. But at the same time, we always install a replenishment system (injector pipes) under the tank floor for future injection after the installation of CorroLogic Powder. On your update, the 1000 reading means the probe has been spent, fully consumed. The fact that you are getting >140 mpy corrosion rate is because of this sudden change in the cumulative metal loss from around 3.8 mils to 25 mils in 30 days. This sometimes can happen over a short period of time when the probe happens to be installed in a very corrosive location under the tank. But, the fact that all the probes are showing the same 1000 reading makes me believe the source of error is the data logger itself as it is the only common factor between all the probes.

We reviewed the data submitted until Sunday April 9th, which is mainly eight data points per probe over 25 days. The data looks consistent and in line with what is expected for ER data in soil environments in the first 60 days. However, due to the limited number of data points over short period of time the data cannot be used to draw conclusions on corrosion rate. With hundreds of ER probes we installed and monitored in the field, ER probes in soil environments have always shown the need for up to 60 days stabilization duration to be able to reliably determine their corrosion rate. ER probes have also shown they are prone to noise and interference from surrounding equipment such as operating pump, instrumentation etc. Therefore, we usually advise our clients not to micro analyze the data, especially in the first 6 months, until enough data is available to determine outliers in the data and perform methodical statistical analysis.

4. 1. When drilling the bore hole in the concrete ring wall, how do you determine the optimum height location before committing to drill the hole – the concern here is that we drill too close to the underside of the steel floorplates or alternatively we drill below the graded material, too far from the steel floor plate.

The optimum height can be determined by reviewing the as-built tank foundation detail drawings. But as a rule of thumb, 10 to 15 cm from the center of the PVC injector to the edge of the concrete ring wall or the tank bottom is a good practice. If the core drilling rig is mounted properly, this shouldn't be a concern. Please remember the coring process should only take place in the concrete structure not the sand. I believe there are ways to control the core drilling depth, if required.

5. With example of the 100-meter diameter tank, when you start inserting your pipework to create the hole for the perforated pipe how do you know the pipe is going in straight both horizontally and vertically. In other words, can you detect any deviation from both the horizontal and vertical axis.

Unfortunately, it is not possible, but it is not critical. We have faced this in multiple projects.

6. I realize every tank will have a different engineered solution. However, for the sake of shipping product to site across Europe, can you estimate how much Corrologic slurry would be required for the above example tank. We just need to know roughly how many IBC, (1000-liter tanks) we would be required to ship with a delivery. We also wondered if we would ship the Corrologic Powder and mix it with fresh water to create the slurry.

You will need 14,142 liters. CorroLogic Powder has silica in it which will never dissolve in water. You still can mix on site and use a suitable sieve or a filter to remove the silica particles. Once you decide which way to go, let's align on the mixing procedure, water quality etc.

7. Obviously, we will be governed by local European and Country specific legislation as what we can and can't do on site. Specifically, in relation to equipment we know that we will have to contain the extracted sand by means of vacuum excavation, like the method used by MESA in the US. However, this means that heavy equipment such as the "FX 30 Ditch Witch", trailer mounted unit would need to be included in our equipment and materials required on site. Alternatively, we are looking at a method where we can insert the perforated plastic pipe (60mm) diameter at the same time we can excavate using an auger arrangement on the inside of the pipe. Insertion of the perforated pipe into the position determined by the CME Engineered Solution is a key element that we want to get right. We realize that between us we will need to develop a solution that allows us to insert the perforated pipework that meets with local requirements throughout Europe.

I agree

8. We have found a source for pre-perforated HDPE OD 32mm diameter pipe with a wall thickness of 6.5mm this comes in 1-meter lengths. We can also use non-perforated lengths where we may not need Corrologic Slurry areas – does this sound like an option?

We recommend ¾" x 6 m long schedule 40 PVC pipes for injector up to 40 m and schedule 80 above 40 m injectors. PVC is believed to be more suitable for direct burial and trenchless installations. It also has smoother surface and is more rigid compared to HDPE, hence, it is easier to push inside sand pads. Can you please share with what you think might be the advantages of using 1-meter HDPE pipe sections?

9. Regarding dispersal of Corrologic Slurry through the perforated pipe, what is the recommended number of holes and what is the optimum diameter of the holes. What is the ideal OD/ID for the pipework.

3/4" schedule 80 has an OD of 26.7 mm and ID of 18.85 mm. schedule 40 has OD of 26.7 mm and ID of 20.9 mm. We recommend 5 mm hole size, 4 holes drilled at the quadrants every 30 cm.

10. We will need a pump and a compressor, that will cope with the dispersal of product. Can you advise regarding size of compressor and pump for the example tank above? We need to know this as we are going to have a containerized unit for all equipment and consumables, so we need to start to design the container based on equipment size.

Attached is online injection equipment, tools and consumables list.

11. In some cases, we think that we might find that the Grade material is not sand and may be a mix of sand / gravel / asphalt. What are the restrictions on the Grade material when inserting the perforated pipe, i.e. Is there some material that is just not practical to drill through installation of pipework?

Installation of PVC injectors while tank in service is only applicable for tanks construction on sand pads and HDPE liner.

12. Is there a problem if the grade material is oil-based sand, does it cause a problem with the water-based slurry?

Online injection is not recommended in case of oiled sand. Injector can only be installed under the oiled sand layer. Diffusion rate of VPCI through oiled sand will be very low, especially if it is an old tank.

13. Again, for calculating space in the container for shipping to Europe to do the sample tank, roughly how many meters of perforated pipe and pipe for the ER Probes would be required – I realize that this will vary, but just so we have some indication.

You will need about 300 LM.

14. PVC pipe details and data sheet used as injector.

We use Schedule 40 PVC 3/4 " Pipe for Probe sleeve and Injector Pipe. I don't have any data sheet now, I will look at and revert you.

15. Connection details between each two PVC pipes.

For connecting two PVC pipes together we use 3/4 " female plane PVC socket.

16. Connection details between the air hose and PVC pipe.

For connecting air hose, we joint 3/4 " female threaded socket with the PVC pipe and with that we attached 1 GI male threaded 3/4" spool piece and then with that 3/4 " gate valve then with that 3/4 " Chicago connection. With this we can connect our air hose.

17. Air compressor rate used for injection of Corrologic Slurry.

Air compressor (375 cfm) we only used for blowing the sand out for injector pipe, we use portable diesel pump for injecting Corrologic slurry underneath the tank.

18. Effect of low temperature application and performance of Cortec inhibitors.

Low temperature lowers the evaporation/sublimation rate of materials, this is the same for Cortec's chemistry. Low temperatures will not stop the inhibitors from performing their core function.

19. What is the optimal temperature for the application of Cortec inhibitors for CorroLogic applications (slurry or powder)?

20-30 °C is the typical application temperature of most of Cortec's products. For many of the Corrologic products, we know that temperatures near and above 100 °C render the product mostly or totally ineffective. Cold temperatures, as stated above, reduce the evaporation/sublimation rate of the vapor phase inhibitors, but do not inherently render the product ineffective (once it has been applied). We have not done studies to identify an optimal application temperature.

20. How is the diffusion rate affected by the temperature and how is it evaluated?

We know the diffusion rate increases with increasing temperature and decreases and decreasing temperature. We have studies or evaluated the exact change in diffusion rates across various temperatures.

21. Is the VCI product acceptable for use for protection of the underside of the tank bottom plates of potable water tanks? Please explain with any approvals from UAEPA or other recognized national international agencies.

VCI product will protect the underside of the tank bottom plates of potable water tank. Since the product will not come into direct contact with potable water and will be placed at the external side of the tank, we do not anticipate needing to meet any such standards. We do have NSF61 certification for similar chemistries in our product range but not for our Corrologic product line.

22. What are the typical Performance Criteria for the application and the Post-Application Monitoring and Evaluation requirements? Could you include a typical Post-Application Monitoring and Evaluation form, with the proposal?

Success criteria of keeping post-injection corrosion rate below 5mpy. For pre-injection corrosion rates of less than 5mpy, a percentage reduction of 70% is adopted.

23. What are the specific HSE and QA/QC requirements to be met? Could you include a typical Job Safety Analysis (JSA) with the proposal?

Please see attached files CME-JSA-001 and CME-JSA-002.

24. Do you have an approved (tested and accepted) methodology for removing samples of the materials (clean sand, bitumen sand, asphalt, etc.) used above the construction pad and beneath the tank bottom plate?

During the installation of the injectors or corrosion probes under the tank bottom plates, it is necessary to remove material from the underside of the tank. We have approved methods among refineries to remove these materials. Final methodology will be adopted after site visit.

25. In the case of our tanks, let us know if you will have to drill through the concrete ring wall, and if so, how that is done?

For the Online application we will drill through the concrete ring wall - please refer to method statement of CorroLogic Online Application technical proposal for more information. For Out-of-Service we do not drill through the concrete ring wall unless we need to install corrosion probes.

26. Duration of site visit of the CORTEC Engineer, and provide documentation and credentials of engineer for verification? As a special case, could you possibly consider visit of the CORTEC Engineer on a no-cost basis to hopefully expedite matters?

Assuming accommodation/flights/visas are arranged by your side, we can allocate a CORTEC Engineer at no-cost basis. We anticipate needing half a day on site so please advise on timing for any inductions needed.

27. What is the typical time (hours/days) to be budgeted for each phase application process mentioned in Item#7 above, assuming the tank is emptied, the upper side of the tank bottom plate cleaned, and the tank provided to you, ready for the application?

Assuming all the above and all permits are available:

Phase 1: Injection system installation – 1 day per tank

Phase 2: Chime area seal system installation – 1 day per tank

Phase 3: Powder injection – 1 day per tank
Note that Phase 1 and Phase 2 can be done in parallel.

28. Weld patch plate repair of the hole produced by coring of the tank bottom plate is required after the application? Is this required to be done immediately after injection?

Weld patch plate is required. It is not required to be done immediately after injection if the injection hole is covered to minimize the migration of VpCI from under the tank to the atmosphere.

29. Can CORTEC application team carry with them to the field all the VCI products, materials, tools, tackles and consumables required for successful application in the field? Or will all these be required to be shipped to and available at Turkmenistan before you mobilize to the facility for application? Are there some general tools/tackles/equipment that you think the site can provide?

We will need to airfreight sealant material and one 50lb drum of Corrologic Powder. Execution team can carry with them application equipment. Dragon Oil will be required to provide:

- Electrical power and potable water if needed
- Suitable storage facilities for the materials
- Compressor with 250 cfm compressed air with hoses
- Requirements specific to out-of-service application:
- Safe and ventilated working environment inside the tank
- Welder and helpers
- Compressor with 250 cfm compressed air with hoses
- Magnetic base drill (can be provided by Cortec)
- Details will be finalized after site visit.

30. Has the CORTEC VCI Technology application undergone a review following the Shell or Petronas Technology Readiness Level Assessment (TRL Assessment) or similar? If yes, then would you be able to share information on the review with Dragon Oil without compromising any existing confidentiality agreements? This, along with a list of successful applications of your technology for similar applications worldwide, will help us in the pre-qualification process I think.

Cortec Corrologic has been used by Aramco, SABIC, SWCC, ADNOC Gas Processing, VTTI, Oxy, Qatar Petroleum, QChem and ORPIC regionally and others globally. It has not undergone review following the Shell or Petronas TRL.

31. Very low corrosion rate after 3 years.

The fact that the probes didn't show any significant corrosion after almost 3 years don't make sense to me. We need to do the following:

1. Review tank foundation detail drawings
2. Review probe installation drawings
3. Review Corrologic Slurry injection drawings
4. Visit the facility and take photos for the location/position of probes
5. Review latest CP data
6. Cross check the functionality of data logger
7. Retrieve the probes and photograph their sensing element and replace them back. Did you remove the VCI paper prior to installation of the probes? "

If CP is active, probes should be grounded to avoid stray current corrosion. This applies for probes imbedded in the sand or in suspended in the annulus space of the monitoring tube. If we are 100% sure that the sensing probe installed in the annulus space of the monitoring tube is electronically isolated, grounding is not necessary. Since most of the time 100% isolation is not guaranteed in active CP systems, it is a good practice to keep all probes grounded. If CP is not active, probes shouldn't be grounded to avoid galvanic corrosion between the probes and the bottom plates.

32. What the coverage for warranty and how many years? Let's say if sealant will have a leakage, or corrosion and degradation of floor will take place.

Service life statement:

Cortec's CorroLogic AST solution is optimized for a ten-year service life which is aligned with the anticipated duration between two consecutive T&Is. Should replenishment or corrective action be required before the end of the design life it will be indicated by the submitted Corrosion Monitoring Reports submitted by Cortec and reviewed by our inhouse Subject Matter Expert who will then propose suitable remedial action based upon findings. A robust chime sealing system is therefore required around the entire perimeter of the tank and the integrity of this sealing system should always be regularly inspected and maintained.

Warranty:

Cortec warrants CorroLogic products will be free from defects when shipped to customer. Cortec's obligation under this warranty shall be limited to replacement of product that proves to be defective. To obtain replacement product under this warranty, the customer must notify Cortec Corporation of the claimed defect within one year after installation of product to customer. All freight charges for replacement product shall be paid by customer. Cortec Corporation shall have no liability for any injury, loss or damage arising out of the use of or the inability to use the products. Cortec guarantees installed CorroLogic product will reduce corrosion rate of installed corrosion monitoring probes by more than 70% with reference to pre-injection corrosion rate or keep it below 5 mpy. In case the installed products didn't perform within the said limits, Cortec's obligation under this warranty shall be limited to injection of

enough quantity of CorroLogic material in vicinity of the subject ER probe as advised by CorroLogic Specialist for up to one year after from injection date.

33. For how long years protective effect will be in place? What the cost for second injection?

Our system doesn't require any maintenance or running cost except for collecting and analyzing data. I suggest we propose biannual report sold at USD 100 per probe. So, if you have a tank with 4 probes we sell the report at USD 400. Ideally speaking, we should consider material cost, supervision cost and any other equipment and mobilization cost, but at least material cost for the replenishment. Percentage is hard to calculate as it really depends on how many probes are not meeting the criteria which determines how much quantity of CorroLogic Material will be required. You can use an estimate between 10 to 25% if they insist to have a value but you can always tell it is on a case-to-case basis.

34. What components from soil/sand can impact the efficiency of inhibitor?

Cortec's inhibitors provide excellent corrosion protection, when incorporated in clean sand in the recommended quantity. They also provide excellent corrosion protection in the sand saturated with Chlorides. In case the sand under the tank is heavily contaminated it is recommended to increase the ratio of the inhibitor per square meter.

35. Chime area seal system - can you explain a little more about the arrangement, because as per Saudi Aramco standard we must provide a 13mm Asphalt membrane layer between the tank bottom and the ring wall foundation. If we are required any modification on this will require Saudi Aramco Approval.

Our chime area seal system is composed of three components; a sealant filler to fill the gap between the annular plates and the ring wall, a wrapping band installed over the annular plate and overlaps with the ring wall to provide protection to the sealant filler, and finally a top coat applied onto the wrapping band to provide UV resistance. I suggest sharing the chime area seal system section in our standard technical proposal, in pdf format, if more details are required. This system has been applied on several tanks for Aramco in the past. I am not sure where this 13 mm asphalt membrane layer is placed under the tank floor. We have inspected and reviewed several tank foundation drawings but never come across this asphalt membrane. Can you ask the customer to provide a typical tank foundation showing the placement of this membrane?

36. You have considered a design life of 10 years, but generally any Mechanical Equipment will be considered around 20 to 30 years and mostly preferred period is 30 years.

Cortec's CorroLogic AST solution is optimized for a 10-year service life. Should any CorroLogic material replenishment or any other corrective action be

required before the end of the design life, it will be indicated in the Site Inspection and Corrosion Monitoring Reports provided by Cortec. The reports will be reviewed by Cortec Subject Matter Expert. Suitable remedial action based upon findings will be recommended. A defect free secondary containment liner and a robust chime sealing system are required around the entire perimeter. Regular inspection and corrosion monitoring for the different system components should be maintained throughout the service life of the tank.

37. I have been reading some articles and research papers about this new technology and come to know that relative humidity and rainfall has impact on the Corrosion inhibitor consumption rate, so how frequently refilling of the Corrosion inhibitor will be required for Saudi Arabia condition and roughly how much it will cost each time refill (percentage of the initial cost of the system).

Tend to agree with this conclusion, however in the presence of a defect free secondary containment liner and a robust chime sealing system there is lower possibility for ingress of rain water or humidity to the under-tank environment. Moreover, the presence of corrosion monitoring system will indicate any changes to the soil-side corrosion rate and enable us to take necessary corrective action.

38. You have not explained impact on the cost reduction in the CP system

Corrologic AST solution is designed to supplement the performance of CP system and work as a second line of defense against soil-side corrosion. Published technical articles have shown that Cortec CorroLogic VpCI products have synergistic effect with CP system. They are cathodic polarizers tend and decrease the CP current required to meet the protection criteria. Having said that the cost reduction to the CP system is not considered substantial by most facility owners.

39. What will be the impact on Environmental as these VPCL are dissolved into the Sand (from research paper we understand it does not impact, however it will be concern in later stage, if you can provide any analysis report it will be better)

Considering the non-hazardous nature of our chemical used in these applications, we do not anticipate any negative impact on the environment. Also, the relative residual concentration of chemical left in sand is almost negligible.

40. Moreover, the price of the initial system is roughly 4 to 5 times higher than CP system and the running cost of the CP will be less compared to the VPCL. Price of the Initial system cost roughly 2 to 5 percentage of total tank cost, so what are the saving can be achieved by using this system. There is a cost analysis is performed based on the actual case.

CorroLogic VpCI product is at par with CP cost. Please note that we propose a chime are seal system and corrosion probes monitoring system as add on to

our core solution, which is not included in typical CP packages. By adding these two systems to the cost of CorroLogic VpCI product it tends to look more expensive than the CP system. The main savings come in the form of cost reduction in the maintenance costs during T&I. by providing protection to the inevitable air gaps between bottom plates and soil pad, where CP current cannot reach, operators minimize the risk of localized corrosion in those areas which results in less bottom plates to be replaced and patched during T&I, which minimizes tank shutdown time.