CORE PRESERVATION PROCEDURES USING MYLAR® HEAT SEAL BAGS

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ABSTRACT

There are many methods used to stabilize and preserve core, both long term and short term. For each method there are good points and bad points. It is very difficult to find one method that can be used in all situations, so we must design or adapt the most applicable method to the current situation, usually based on the type of rock we are coring. One of the most challenging types of rock with which to work are carbonates. Carbonates can have all sorts of holes, vugs and fractures within a very short length of core. This presents a real problem in finding a way to keep the rock in 'native state' condition during transport and for long term storage. The types of analyses needed for carbonate rock, usually whole core, eliminates the use of epoxies, gypsum or expanding foam as a viable choice because these systems will fill the holes and fractures and are impossible or impractical to remove. This preservation method fulfills the need to both stabilize the core inside of an inner barrel or container and isolate the core from the external environment. The use of heat sealed bags has been used for long term storage for many years. This system goes one step beyond by keeping the core isolated inside the inner barrel from well site to the laboratory or core storage.

INTRODUCTION

Core preservation is the process by which rock core samples removed from a drill well are isolated from the environment in preparation for transportation and/or long or short term storage. Core samples removed from the well bore contain reservoir fluids, oil, gas or water, either singly or in combination. Different techniques may be used to accomplish the desired goal, keeping the reservoir fluids in and any contaminants out. These techniques fall into three categories, encapsulation, submersion or envelopment. This document describes the procedure for enveloping a section of core contained in a conventional inner core barrel or an Aluminum liner.

A Mylar® heat seal bag is used because it is airtight, once it has been sealed. Water vapor transmission rates indicate that if sealed properly, the core can be isolated from the outside environment for many years, thus retaining in-situ fluids and avoiding contamination from air and moisture. The bag is a layered composite of Nylon, Aluminum foil and Polypropylene. It is sealed using either a constant heat sealer or impulse heat sealer. Care must be taken to ensure that the core tubes have no sharp edges or 'upsets' that might cause the bag to tear or be punctured. The bags should be wide enough that the core tube can easily fit inside and long enough to contain the core tube with an additional 1½ feet or 40-50cm for processing requirements. This additional length allows repeated use of the same bag once it has been opened at the core laboratory.

The preservation of carbonate core requires special techniques due to the nature of the rock. Carbonate rock often has varying size holes or vugs within the matrix. Because of these vugs, the rock is generally heterogeneous and problems can arise in scaling up data from core plug size, typically 1½" diameter, to reservoir sizes. One method of obtaining more reliable data is performing whole core analyses. Performing special core analysis tests (SCAL) requires several core plugs in as close to a 'native state' condition as is possible. Both of these reasons require maintaining the integrity of the holes or vugs. For this reason, encapsulation of the core with epoxy or other material is not acceptable because these types of materials will also fill the holes or vugs and cause a change in the 'native state' of the rock.

There are two types of core containers available, conventional inner core barrels and inner core barrel liners. Both of the container types are available in Fiberglass or Aluminum. The liners are available in either longitudinally split or whole tubes. If on-site investigation of the core is required, the split liners are recommended. If the core is to be stored for a long period of time prior to analysis, i.e. 1 or more years, either the conventional barrels or whole liners are recommended.

This procedure will describe preservation of carbonate cores collected in split tube liners. The procedure may also be used on conventional inner barrels or whole tube liners following the stabilization of the core within the tubes. It is also applicable to other consolidated, competent rock types.

STABILIZATION / PRESERVATION PROCEDURE

1. Cut the long core barrel/liner into 3 foot or 1 meter sections.
2. Place a rubber end cap on each end of the section. This prevents the core from falling out between the saw and the preservation area.
3. Using a permanent marker, mark the core section with Well ID, Core#, Section#, Top depth, Bottom depth, orientation stripes (red on right of another colored line, looking from bottom to top).
4. Allow any excess drilling fluid to drain out through a hole placed in the bottom end of the end cap.
5. Remove the end caps, ensuring that the core does not fall out of the tube.

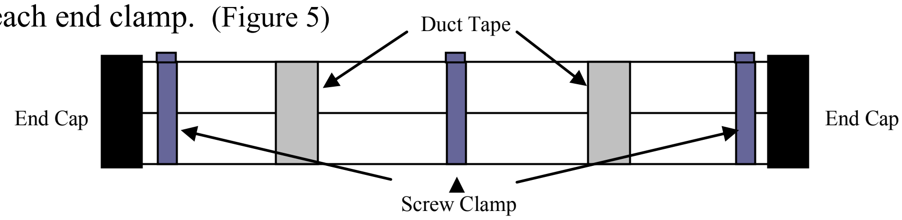
NOTE: Steps 1 through 5 are the same whether the core container is complete or split. For complete containers, the core is stabilized by inserting appropriately sized PVC rods or PVC wedges in the annular space between the core and container. Skip to Step 14 and continue with preservation.

6. Remove the top half of the liner, exposing the core. (Figure 1)
7. Mark orientation stripes on the core, red on the right from bottom to top. (Figure 2)

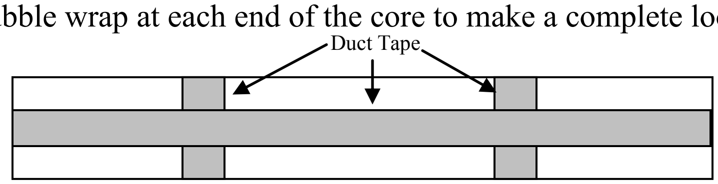
8. Perform any necessary data collection on the exposed core, i.e. photography, description, plugging.

   NOTE: Any time the core is exposed to the atmosphere increases the possibility of wettability alteration. Limit the time to less than 10 to 15 minutes.

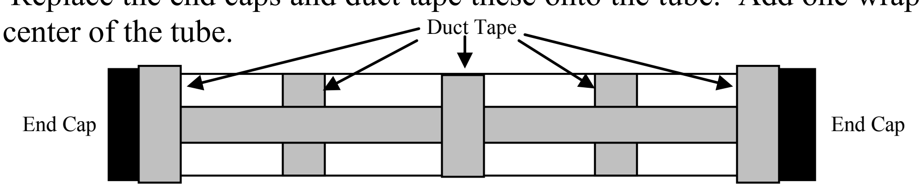
9. Cover the top of the core with a double layer of bubble wrap. The bubbles should be of small diameter, +/- 0.5" or 1cm. The covering should be the entire length of the core section and covering each end of the core. (Figure 3)
10. Replace the top of the tube making sure that the orientation of the tube is correct.
11. Cover the ends of the tubes with rubber end caps, with no holes.
12. Using quick connect screw clamps, secure the top and bottom of the tube together. Placement should be one at each end, not on the end caps, and one in the center. (Figure 4)
13. With duct tape, wrap the tube at the point midway between the center clamp and each end clamp. (Figure 5)



14. Remove the quick connect screw clamps and end caps and then apply duct tape along the split line in the tubes. It is OK to tape from one side to the other over the bubble wrap at each end of the core to make a complete loop.



15. Replace the end caps and duct tape these onto the tube. Add one wrapping to the center of the tube.



   NOTE: ALL duct tape wrapping should be done without rotating the core or tube.

16. If necessary, remark the tube to show Well ID, Core #, Sect # and depths.
17. Wrap the entire core tube with plastic wrap, such as Saran Wrap or stretch wrap.

   NOTE: It is OK to stand the core tube vertical to wrap but it is NOT OK to rotate or roll the core tube over the wrapping. Completely cover the tube, including the rubber end caps. (Figure 6)

18. Wrap the entire core tube with heavy duty Aluminum foil. Follow the same guidelines as with the plastic wrap (step 17).

19. Apply one wrap of duct tape at each end of the tube and in the middle to secure the Aluminum foil.
20. Mark the tube with top and bottom depths, Well ID, Core # and Sect #. Affixing a paper label can replace hand marking.
21. Insert the wrapped core tube into the Mylar heat seal bag all the way to the sealed end of the bag. Care must be taken to ensure that the tube does not tear, rip or puncture the bag. (Figure 7)

    NOTE: The Mylar bag should be pre-marked with Well ID, Core#, Sect#, “T”, “B”, depths and orientation stripes (red on right, looking bottom to top).

22. The process manifold is attached onto the Mylar bag through a pre-punched hole and secured with a flange nut inside the bag. The hole should be located +/- 3-4 inches or 10cm from the end of the bag. (Figures 8 and 9)
23. The end of the Mylar bag is then sealed with a heat sealer. This can be a constant heat (recommended) or impulse heat sealer. Inspect the seal to see that it is effective. The seal should be close to the edge of the bag. (Figures 10 - 12)
24. Attach flow lines to the manifold, one from the Nitrogen tank and one from the vacuum pump. These should be a quick connect type. The Nitrogen tank should be regulated with a two stage regulator to +/- 10psig. (Figure 13)
25. Open the vacuum valve to the bag. The Nitrogen valve should be closed.
26. Pull a vacuum to evacuate the bag. Some crinkling of the bag will be observed and some manipulation of the bag to avoid being drawn onto the manifold opening on the inside of the bag. The vacuum should not be left on for more than 1 minute. (Figure 14)
27. Close the vacuum valve and open the Nitrogen valve. Allow N_2 to enter the bag until the bag starts to ‘balloon’.
28. Close the Nitrogen valve and open the vacuum valve. Pull a vacuum so that the bag collapses in a controlled fashion leaving any ridges along the sides of the core tube. The vacuum should not be left on for more than 1 minute. (Figures 15 - 18)
29. Position the heat sealer between the core tube and the process manifold, close to the manifold and seal the bag. Ensure that the bag is sealed completely across the bag. (Figures 19 and 20)
30. Close the vacuum valve.
31. Using a box or utility knife, cut across the bag between the seal and the manifold to separate the manifold from the bag. (Figure 21)
32. Inspect the seal from the outside opening to see that the bag is sealed. If it is not, the process must be repeated using a new bag or by punching a new hold in the bag if there is adequate length to repeat the process. (Figure 22)
33. Carefully, so as not to puncture the bag, put the preserved core tube into a multi-section core shipping container and isolate it from other core tubes with foam padding. (Figures 23 and 24)

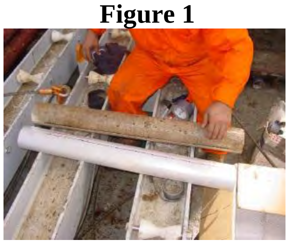
CONCLUSION

This procedure calls for a cycling of vacuum, Nitrogen and vacuum. This process is used to replace atmospheric air with a dry non-oxygenated gas. Weathering in rock samples occurs as a result of oxidation and reaction with water/water vapor. This process removes excess atmospheric air, which will contain Oxygen and moisture but does not create such an under balance that fluids are pulled from the core. The Nitrogen cycle acts to dilute any atmospheric air remaining in the bag following the first vacuum stage. The second vacuum removes the 'contaminated' Nitrogen leaving any remaining gas in the bag composed of a high concentration of Nitrogen and natural gases.

Using this procedure the cores may be transported to the laboratory and retained for a lengthy period of time, years, until ready for analyses. Once at the lab, the cores may be CT scanned and analyzed for natural gamma ray activity (core gamma) while remaining in the bags.

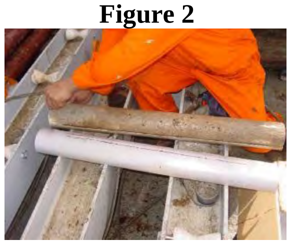
Photographs of Mylar® Heat Seal Bag Preservation Technique

Figure 1



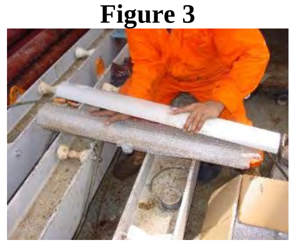
Labeled Core Section

Figure 2



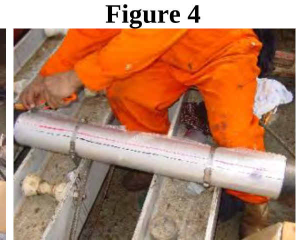
Add Orientation Lines

Figure 3



Stabilizing with Bubble Wrap

Figure 4

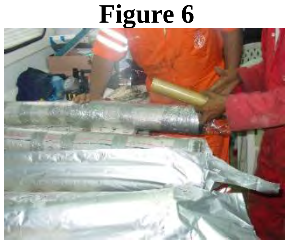


Securing Top to Bottom

Figure 5

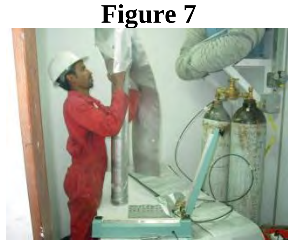
Duct tape tube and End Caps

Figure 6



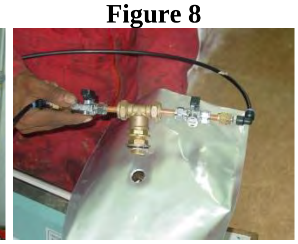
Wrap in Plastic & Al Foil

Figure 7



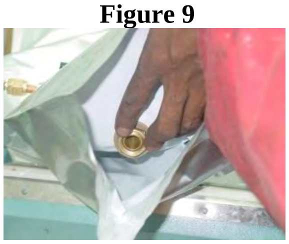
Core placed in Heat Seal Bag

Figure 8



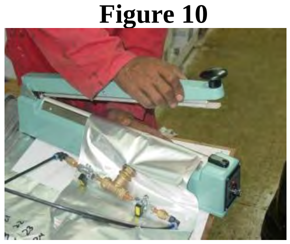
N2/Vacuum Manifold attached

Figure 9



Secure Manifold to Bag

Figure 10



Sealing Manifold in bag

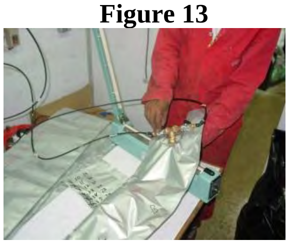
Figure 11

Heat Sealer on Bag

Figure 12

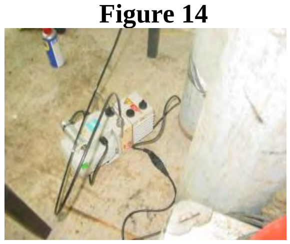
Core and Sealer Location

Figure 13



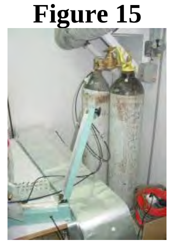
Alternate using Valves

Figure 14



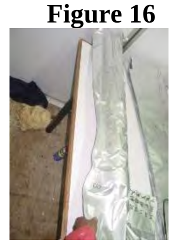
Vacuum Pump

Figure 15



Nitrogen Tanks

Figure 16

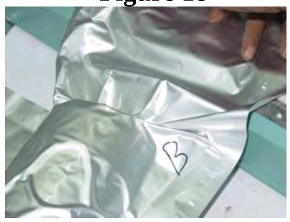


Bag with Core

Figure 17

Cycle Vac//Nitrogen/Vac

Figure 18



Bag after Final Vacuum

Figure 19

Bag sealed upstream of Manifold

Figure 20

Heat Seal across Bag

Figure 21

Manifold separated from Bag

Figure 22

Sealed Bag

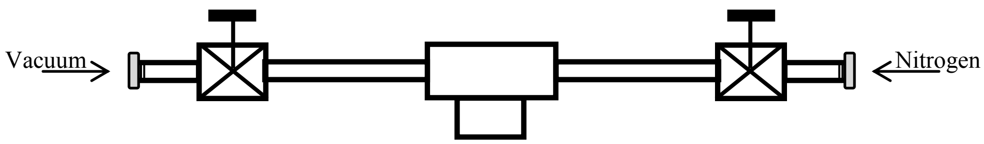
Figure 23

Cores ready for Shipping Box

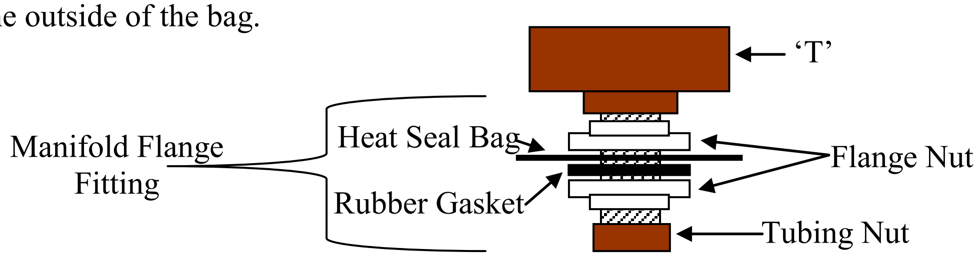
Figure 24

Core in Shipping Box

The manifold is made of metal tubing, metal valves and fittings. There are quick connect plastic tubing fittings for attaching nylon tubing coming from the vacuum pump and the Nitrogen cylinder. The center 'T' is the connection point for attaching to the heat seal bag.



The flange fitting that connects the bag to the manifold should be metal but should not have a sharp bottom, which will be inside of the bag. A tubing nut will suffice in shielding the bag from a sharp edge on the flange. There should be a rubber gasket between the flange nut inside the bag and the bag, itself. The outside flange nut will seal on the outside of the bag.



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