

Application Study of Pottery Clay Adhesive on Structure Enclosure for Water Proof and Pressurization Condition.

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Abstract:

The main goal of this research work is to develop an adhesive to seal the enclosure areas with defined pressure of 1.3 to 1.35 bars and also protected by rain. Then structure enclosure is fabricated as per requirement. The pottery clay with combination of resin and hardener mixed together forming an adhesive. Applied over the enclosure corners, openings and also fastened with bolts. Then pressurization is done tested for leak proof and water proof. Further, it has been observed the pottery clay adhesive is suitable for the application.

Key words: Pottery clay adhesive Lap joint, analysis.

- Pour the weighted pottery clay on the plate.
- Add AW106 and hardener into it.
- Start mixing by manually using putty scraper thoroughly until it mixed.
- Add epoxy paint hardener into it and mix thoroughly for 1 to 2 minutes.
- A proper mixture appeared with solid viscous in nature.
- The mix is ready to use.
- Curing is done at room temperature for a period of 16 hours after application of adhesive.

INTRODUCTION:

The main role of canister pressurization is to obtain the safe transportation of missiles from one place to another. Nitrogen gas is filled inside the canister to avoid fire accidents during storage and transportation. In the present study an Adhesive made from clay and epoxy resin is developed, tested and applied across steel structures to test the structure enclosure free from air and water leakage so pressurization can be achieved.

Proposed methodology:

Objective of proposed methodology

- Fabrication of enclosure considering the openings top plate fastened by bolts, structure built up for pressurization and adhesive application to the surface and corner in order to ensure leak proof.
- Fabricated enclosure applied by pottery clay adhesive is also tested with rain test methods.

Preparation of pottery clay adhesive and shear strength testing.

- Preparation of Pottery clay adhesive : - Manual mix method
- Weight the pottery clay , Araldite AW106, Hardener HV 953 U and Epoxy paint hardener as per the required percentage using weighting balance.
- Keep aside for mixing.

Preferred proportions of the individual ingredients are shown in Table 1:

Sl no	Type	Weight percentages
01	Pottery clay	50
02	Araldite Epoxy AW106	21.4
03	Hardener HV 953U	16.3
04	Epoxy paint hardener (South field paint)	12.3

ASTM D-1002 test procedure: ASTM D-1002 determines the shear strength of adhesives for bonding metals when tested on a single-lap-joint specimen. Two metal plates are bonded together with adhesive and cured as specified. The assembly is then cut into uniform width lap shear specimens. The test specimens are placed in the grips of a universal testing machine and pulled at 1.3 mm/min (0.05 in/min) until rupture occurs. The grips used to secure the ends of the assembly must align so that the force is applied through the centerline of the specimen. The type of failure can be either adhesive (the adhesive separates from one of the substrates) or cohesive (the adhesive ruptures within itself).

Specimen size: The recommended lap shear specimen is 25.4 mm (1") wide, with an overlap of 12.7 mm (0.5"). The recommended metal thickness is 1.62 mm (0.064") and the overall length of the bonded specimen should be 177.8 mm

(7''). The specimen failure should occur in the adhesive and not in the substrate – thus the metal thickness and the length of the overlap may be adjusted as necessary. Adhesive is applied based on manufacturer recommendations.

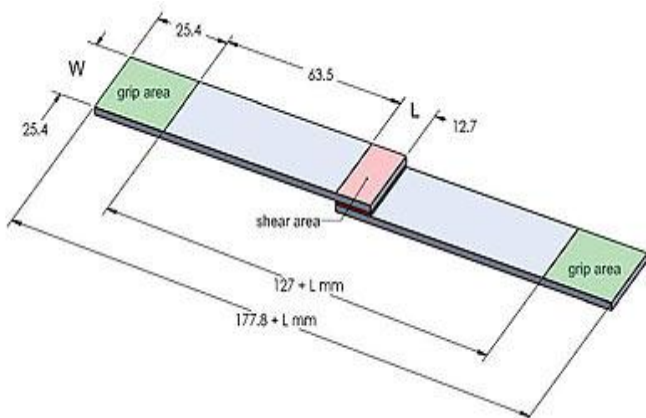


Figure 1. Sample specimen diagram.

Results of lap shear samples of pottery clay adhesive as per ASTM D 1002

45 micron pottery clay size.	SL#	Bonding Length In mm	Bonding Width In mm	Load In(Kgf)	Strength In(Mpa)
	1	12.7	25.2	325.4	9.97
	2	12.9	25.35	330.35	9.91
	3	12.8	25.5	328.9	9.89
	4	13.18	25.2	321.88	9.51
	5	13.1	24.8	307.16	9.27

Fabrications of test jig enclosure:

Test jig enclosure is fabricated using Mild steel plates of length, breadth and height (810x610x540mm) and joined by welding and one end kept open which is fastened by plate. The test jig is made suitable to test the pottery clay adhesive with following points are considered.

- Fixing provision for Non return valve and Pressure gauge are made on the test jig.
- Dirack 2261003 make sealing tapes are used to fix the opening plate with fasteners.
- One end is kept open and fastened by bolts with top cover.
- Pottery clay adhesive is applied to the entire corner and made ready for test.



Figure 2. Structure enclosure



Figure 3. Structure enclosure at rain test chamber.

Test Procedure:-

- Place the test jig on the floor.
- Mount the non return valve and pressure gauge.
- Apply pottery clay adhesive at the corners and leave it to dry for period of 16 to 20 hours.
- Fix the top plate with dirack sealing tape along with mounting of bolts.
- Fill the air in to the container up to pressure of 1.3 bars.
- Check for any leakage with soap water bubble method.
- Monitor for a period 2 hours and proceeding up to 24 hours if required.
- Conduct rain test for a period of 1 hour to detect any leakage of pressurization by this water leakage proof is ensured.

Standard opted for testing pressurization: As per requirement scope fill the pressurized air / nitrogen gas into the all the canisters, till the pressure inside each canister reaches 1.3 bar to 1.35 bar (A). The pressure gauge on canister will show the reading. Then Check the pressure inside the canisters after 8 hours. It should be $\geq 1.3 - 0.1$ bar (A).

Table 4:-Test is conducted as per the procedure and results are tabulated.

Sl no	Hours	Absolute Pressure in Bars	Results
1	0	1.32	Initial reading
2	24	1.32	No leakage
3	48	1.30	drop by 0.02 bar
4	72	1.30	-
5	96	1.28	drop by 0.02 bar
6	120	1.28	-
7	144	1.26	drop by 0.02 bar
8	168	1.26	-
9	192	1.24	drop by 0.02 bar
10	216	1.24	-
11	240	1.22	drop by 0.02 bar
12	264	1.22	-
13	288	1.20	drop by 0.02 bar
14	312	1.20	-
15	336	1.18	drop by 0.02 bar
16	360	1.18	-
17	384	1.16	drop by 0.02 bar
18	408	1.16	-
19	432	1.14	drop by 0.02 bar
20	456	1.14	-
21	480	1.12	drop by 0.02 bar
22	504	1.12	-
23	528	1.00	Drop by 0.02 bar. Final reading.

Table 5: Test summary

Sl No	Name of test	Name of standard	Specifications	Duration	Environment conditions	Results
01	Driving rain test	as per JSS 55555:2012	Static pressure 200kpa Rain flow rate 450 liter/hr Rain fall 250 mm/hr	1 hour	Water temp 24.8 degrees ,Chamber temp 30.1 degrees	No leakage observed.

Rain test was conducted as per JSS 55555:2012 Standard. Test jig is filled with pressure of 1.32 bars and positioned inside the rain test chamber.

RESULTS AND DISCUSSIONS

From Table 4 and Table 5 it has been inferred that there was no leakage of pressure observed for a period of 8 hours and also Pressure drop verified for a period of 528 hours. No cracks were observed on the adhesive seal and also no leakage observed during rain test.

CONCLUSIONS

- The pottery clay adhesive is applied to the enclosure structure and tested with pressurization of 1.3 bars successfully demonstrated for period of 8 hours without any leakage of pressure.
- No leakage observed with rain test conducted for a period of 1 hour.
- Shear Strength of Lap shear samples prepared and tested found to be within the limits of 9.2 to 9.97 Mpa.
- By the above experiment results we conclude the pottery clay adhesive is suitable for canister pressurization applications.

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