contained within the utility vault or pit. Heavy covers can cause injury or other back problems to workers during removal and reinstallation of the covers.

Utility vault and pit covers are also made of plastic but these have limited application for use in areas where they are subjected to less load, i.e. green belt or yard applications. The problem with plastic lids is that because they cannot withstand substantial loads, they have limited applicability and plastic lids provide less coefficient of friction when wet versus polymer covers. Consequently a need exists for a new utility vault and pit cover design which is light in weight, yet is durable in that it can withstand substantial loads and provide improved slip resistance over currently available covers.

SUMMARY OF THE INVENTION

The present invention in an embodiment seek to provide an improved utility vault cover or lid which is manufactured from a fiberglass reinforced polymer matrix material producing a reduced weight and increased strength cover which is lighter, stronger, has improved UV characteristics and slip resistance and is less expensive to manufacture compared to existing cover designs. The lid or cover is used for vaults, pits, chambers or boxes and for ease of presentation shall all be referred to herein as a vault. Vaults are used in a number of industries including utility, security, gas and rail, for example, where they are underground, buried or at grade level.

According to a first aspect of the present invention, there is provided a method of manufacturing a fiber reinforced polymer material lid for an utility vault comprising the steps of: mixing an unsaturated polyester thermosetting material into a resin paste; compounding the paste into a fiber reinforced composite material sheet; maturing the compounded fiber reinforced composite material sheet; cutting the matured compound sheet into a charge pattern; molding the

charge pattern in a mold cavity of a heated mold to form the lid, wherein molding the charge pattern in the mold cavity includes forming at least one continuous support rib extending through a cavity on a bottom surface of the lid and forming a plurality of protrusions into a substantially flat upper surface of the lid to create a resin rich layer above individual fibers of the fiber reinforced composite material sheet; and cooling and machining the lid.

There is also provided a mold for molding a fiber reinforced polymer material utility vault lid comprising: a cavity die; a core die having a telescoping shear edge for interfacing the core die within the cavity die, wherein the lid is molded between the cavity die and the core die; and a lid ejection mechanism for removing the molded lid from the mold.

The fiberglass reinforced polymer matrix (FRPM) material is a fiber reinforced polymer material which consists of an unsaturated polyester thermosetting resin matrix, glass fiber reinforcement and inorganic or mineral filler. Additional ingredients are low-profile additives including a UV inhibitor, cure initiators, thickeners, process additives and mold release agents. The formulation undergoes a cross linking reaction when cured under heat and pressure. The fiber reinforced polymer material for the cover will retain its original material

WHAT IS CLAIMED IS:

1. A method of manufacturing a fiber reinforced polymer material lid for an utility vault comprising the steps of:

mixing an unsaturated polyester thermosetting material into a resin paste;

compounding the paste into a fiber reinforced composite material sheet;

maturing the compounded fiber reinforced composite material sheet;

cutting the matured compound sheet into a charge pattern;

molding the charge pattern in a mold cavity of a heated mold under pressure lower than 20.6MPa (3000psi) to form the lid, wherein molding the charge pattern in the mold cavity includes forming at least one continuous support rib extending through a cavity on a bottom surface of the lid and forming a plurality of protrusions into a substantially flat upper surface of the lid to create a resin rich layer above individual fibers of the fiber reinforced composite material sheet; and

cooling and machining the lid.

2. The method of claim 1 wherein the mixing step comprises combining polyester resin, polystyrene, a catalyst, a UV inhibitor, a fiber wetting additive, a mold release agent and an inorganic or mineral filler.

3. The method of claim 2 further comprising adding a thickener and a color pigment.

4. The method of any one of the preceding claims wherein the compounding step includes:

transferring the resin paste to a first doctor box and a second doctor box;

depositing a first layer of resin paste from the first doctor box onto a first carrier film;

depositing reinforcing fibers onto the first layer of resin paste on the first carrier film;

depositing a second layer of resin paste from the second doctor box onto a second carrier film;

layering the second layer of resin paste on top of the first layer of resin paste containing the reinforcing fibers; and

compacting the first layer of resin paste, reinforcing fibers and second layer of resin paste to form a sheet.

5. The method of any one of the preceding claims wherein the maturing step comprises chemically thickening the sheet.

6. The method of any one of the preceding claims wherein the molding step comprises the steps of:

compressing the charge pattern in the mold;

transforming the charge pattern from a resin paste into a viscoelastic liquid;

filling the mold cavity with the viscoelastic liquid;

evacuating air from the mold cavity; and

curing the low viscosity liquid in the mold cavity under heat and pressure lower than 20.6MPa (3000psi).

7. The method of any one of the preceding claims wherein the resin matrix paste comprises about 10% to about 40% polyester resin.

8. The method of any one of claims 1 to 6 wherein the resin matrix paste comprises about 5% to about 30% polystyrene.

9. The method of any one of claims 1 to 6 wherein the resin matrix paste comprises about 15% to about 50% inorganic or mineral filler.

10. The method of any one of the preceding claims wherein the compounded fiber reinforced composite material comprises about 5% to about 60% fiber glass.

11. The method of any one of the preceding claims further comprising the step of automatically loading the charge pattern into the mold cavity and removing the molded lid and moving the molded lid to a machining station.

12. The method of claim 11 wherein the step of automatically loading the charge pattern and removing the molded lid and moving the molded lid is by a robot.