Selecting a Pharmaceutical Manufacturing Suite Wall Finish System; A Field Study

One of the key issues that must be considered in either the new construction or remodeling of existing pharmaceutical manufacturing suites is the selection of a durable wall finish system. The selected system must have the following characteristics;

a) Ability to withstand high pressure detergent washing
b) High durability
c) Easy maintenance
d) Static-resistance (to prevent product materials from adhering to the wall surfaces)
e) Easy sealing of utility penetrations
f) Meet the California Building Code for smoke and flame spread ratings

A major pharmaceutical manufacturing company recently experimented with several different wall finish systems that included the following;

4' high, stainless steel wainscoting with epoxy painted wall board to the ceiling

Although the stainless steel wainscoting was found to be a good, durable surface, it was subject to denting from impact with the large stainless steel product transfer bins. Further, even with caulked, stainless steel battens at the vertical panel joints, the joints tended to become damaged due to product bin impact over time and water was able to get behind the joint covers and into the interior wall cavity. Also, water eventually broke-down the painted finish on the upper-wall gypsum board- particularly at the tape joints.

Elastomeric paint over gypsum wall board.

This paint system was touted as a clean room finish system that was durable and could accommodate wall wash-down systems. Although the elastomeric paint was easily cleanable and appeared to be chemically resistant to the detergent, the paint was applied over a “wet-rock” gypsum board substrate. It was difficult to protect this substrate from impact damage caused by the product transfer bins. Any moisture that did manage to penetrate the wall system then tended to cause mold build-up on the interior face of the paper-backed gypsum wall board. Further, and from our experience most critically, the elastomeric paint finish could be “cut” or “sliced” due to product bin impact. When this occurred, during the wall wash-down process water penetrated behind the elastomeric paint and “bubbled” the wall surface. These “bubbles” had to be lanced, dried, and then repainted- all of which required that the room be taken out of service and then re-certified before coming back into service.

Epoxy painted Concrete Masonry Unit (CMU).

The most durable manufacturing suite wall system we found was epoxy painted, CMU. There was maintenance involved in the periodic repainting of these walls, but this was relatively minor. There was also the potential for cosmetic damage caused by product transfer bin impact, but this also tended to be relatively minor. When designing new product manufacturing suites, epoxy painted, CMU walls should definitely be considered. However, there are several issues with CMU walls that need to be considered. First, remodeling of suites with existing CMU walls is not as easy or as inexpensive as remodeling existing

steel stud walls- consequently, CMU wall systems tend to allow less flexibility down-the-line-for modifications or up-grades to existing production rooms. Further, many existing manufacturing suite walls are already steel stud construction with gypsum wall board finishes. Replacing existing steel stud walls with CMU is expensive, requires additional floor space (because of the depth of the CMU's) and may require cutting and then reinforcing the existing concrete slab under the CMU due to the weight of the CMU.

PVC wall panels over fiber-reinforced wall board.

The wall system that we found that combined the greatest durability with the best moisture protection, while maintaining flexibility of construction was 1/8" PVC wall panels with heat welded seams adhered with mastic to fiber-reinforced wall board over steel studs. We discovered this material though an on-line product search, but because we could not locate a similar type of wall installation using this material in the pharmaceutical context we required, we conducted a careful field study of this system prior to installing it in one of our major pharmaceutical manufacturing suites.

To test this material, we first hung two 8'x8'x3 ½" deep wall panel "mock-ups" on the walls of one of our equipment washrooms. When material product bins have been emptied in the production rooms, they are taken to the equipment washrooms for a full cleaning. Consequently equipment washrooms are wet rooms, with high humidity and the walls are subject to much contact with the product flow bins. The existing washroom we selected for testing our PVC wall panels had CMU walls. We furred-out two sections on the CMU walls- 8' high x

8’ wide x 3 ½” deep- and screwed fiber-reinforced wall board to these studs as a substrate surface. We masticed the PVC wall panel material to one of these panels and the other 8’x8’x3 ½” deep panel we painted with epoxy paint.

We selected 5/8” USG Fiberock wallboard as the substrate material for our test walls as this material has a 1 hour fire rating, is impact resistant, and moisture & mildew resistant. The 1/8” PVC wall panel material we selected has pre-formed corner and edge pieces so we were able to see how the edge conditions held-up both to the wet environment and the impact with product flow bins. We also drilled ½” diameter holes through both of the test panels and inserted sections of ½” copper tubing through the panels- to simulate utility piping wall penetrations- and then caulked the joint penetrations.

After three weeks the painted wall board panel was completely deteriorated due to impact with the material bins and the moisture conditions of the room and had to be removed. The wall panel with the PVC wall covering was left in-place in the washroom for over a year. During this test period, periodic inspections were made to ascertain the condition of the panel. The only noted condition that required repair was a small section of the caulking at the intersection of the PVC panel and the existing CMU wall. Both the caulking at the test utility penetrations and the heat-welded panel seams held firmly during the entire test period. After a year, when the panel was finally removed from the wall, there appeared to be no moisture penetration into the interior of the test wall cavity.

PVC wall system Lessons Learned

Two lessons-learned were noted during the PVC wall system test installation. First, the new, fiber-reinforced wall board was initially prime and painted prior to the installation of the PVC wall panels. It was noted that the PVC wall panel mastic would not adhere to the primed wall board. The wall board had to be “skim” coated with joint compound- to cover the priming paint. When this was accomplished, the mastic successfully adhered the PVC panels to the wall board. All future PVC panel installation required only the “skim” coating of the new wall board- no primed painting.

In the field test, the 8’x8’x3 ½” studs were hung from the existing CMU walls- consequently no wall base condition was tested. In future installations of the PVC panels, two base conditions were tested-

a) The PVC panels were held 6” above the finish floor and the production room epoxy flooring system was extended up the walls 6”, serving as a 6” epoxy cove base for the walls.
b) In an alternate installation, a ¼” thick stainless steel floor bump guard was installed that extended from the epoxy floor to 12” above the finish floor.

Both base conditions were found to be satisfactory, but the stainless steel bump guard was found to withstand impact better- for example, from product pallets and pallet jacks.

Three final notes- first, per the manufacturer’s literature, IsolTech, the brand name of the PVC wall material, meets the California Building Code for

smoke and fire spread- which is important for both code compliance and insurance requirements.

Second, an alternative to the USG Fiberock wall board is GP DensArmor Plus wall board. Both wall board materials are moisture and mildew resistant and appear to be about the same cost, but the DensArmor plus is a much lighter material. This translates to easier installation- but may the wall board may have slightly less impact resistance.

Finally, it was very important to have an installer who was familiar with the IsolTech PVC panel product. We basically trained our installer- beginning with the simple, 8x8x3 ½" test panel with test utility penetrations, followed by a small production room installation- approximately an 8' x 10' room with relatively few wall penetrations- to finally a two story, large scale production room with multiple utility penetrations and numerous wall indentations.

Both panel joints and the caulk joints at utility penetrations are the potential weak points in this panel system- places where moisture can enter the wall cavity- and it is important to have an experienced installer who can carefully measure and pre-cut each PVC panel to accommodate the various utility and joint conditions. However, with an experienced installer, our Production operators reported that the PVC wall system was easily cleanable as well as highly durable and highly resistant to the heavy wash down requirements of pharmaceutical manufacturing production rooms.