



Industrial Flooring - An Analysis of Various Options



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The function of an industrial floor is to provide trouble-free movement of man, machine, materials and material-handling equipment. Other than the stated obvious functions, floors are often called upon to provide:

- Hygienic/anti-bacterial (Seamless, joint-less)
- Highly cleanable(cold water, hot-water, steam, disinfectants etc)
- Wear (abrasion) resistant.
- Chemical Resistant. (acids, alkalies, solvents)

- Resistance from Impact and Static Loading.
- Ease of Maintenance.
- Anti-slip/anti-stain properties
- Flammability and Fire Safety.
- Scratch/scuff resistance

The specifier of an industrial flooring either the production manager or the maintenance manager or the project manager have a plethora of options and are often not sure as to the right kind of product that would meet all or many of

their requirements. Some of their requirements are often conflicting with each other such as "an anti-skid flooring is often not easily cleanable" or as "Highly chemical resistant flooring is not always highly abrasion-resistant" etc.

Concrete floors, though most durable performer may not meet many of the desired requirements enumerated as above. The aim of this article is to analyse various available flooring options so as to help the specifier/user narrow down their choices.

Some of the floorings analysed here are as follows:

1. Vacuum-dewatered high-strength concrete flooring (M20 to M35)
2. Infloor Particle Flooring
3. Floors broadcast with floor hardeners (metallic or non-metallic)
4. Floors armoured with floor resurfacers combined with Liquid Floor-hardeners
5. Epoxy/PU polymer floorings

Option I: Vacuum de-watered Concrete floor

Vacuum-de-watered floor, invariable known as VDF or Tremix floor continues to be the most preferred and cost available floors for various industries for many years. It can be simplified as consisting of the following steps:

- Concrete of the required grade such as M20, M25 etc (basically means having a compressive strength of 200Kg/cm², 250Kg/cm² etc) are poured over the PCC and reinforcement bars as per design.
- Vacuum de-watering (VDF) is a process by which excess water is removed in a controlled fashion by applying vacuum
- The concrete is then power-trowelled to obtain a smooth and dense concrete
- VDF floors are known to provide a good concrete floor and is known to achieve strength earlier than a control concrete
- However, contrary to the popular belief, for a specified design mix, the compressive strength cannot be more than the targeted strength.
- Due to controlled water-removal as well as power-trowelling, the surface is quite dense and levelled and hence is expected to provide a better abrasion resistance than a non-VDF concrete floor.

The advantages and disadvantages of a VDF can be tabulated as below

Advantages

- It is the most cost-effective solution as the cost of laying M35 concrete is cheaper than other options.
- It can be laid by any quality flooring contractors
- Durable
- Fairly maintenance-free

Disadvantages

- The inherent porosity of the concrete allows water, oil

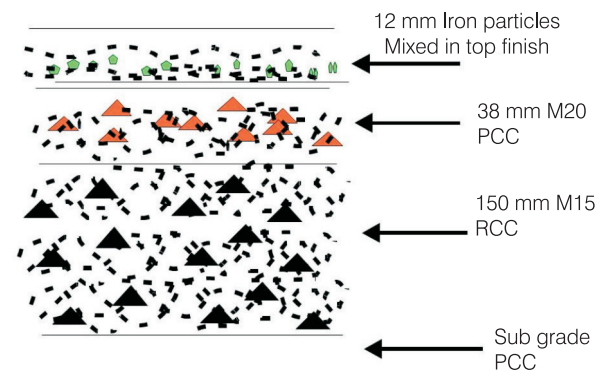
and grease to seep through, consequently weakening the concrete.

- Joints are a necessity for concrete floors (to accommodate shrinkage, thermal movements etc) which can lead to joint-breakage as well as seepage of the above contaminants.
- Concrete floors generate dust due to abrasive movement of vehicles commonly found in industrial plants which can cause tangible and intangible damage to plant and machinery, sub-assemblies etc.
- Cleanability becomes a problem due to the presence of imperfections, surface roughness and porosity.
- The best-laid floor (Tremix) can have undulations of above 5mm (not normally visible to naked eye). While it is typically accepted in various engineering industries, it must be kept in mind that heavy movement of vehicles can wear out the surface faster

Option II: Infloor Particle Flooring

Another flooring system that has been in practice for a long time, especially for heavy traffic industrial flooring is known as Infloor particle flooring. Once, the base concrete floor is laid, an additional 50 to 75 mm concrete topping (out of which the top 12mm inter-mixed with iron particles of specific particle-size) is poured over the base-concrete and leveled manually. Water-curing is done for another 28 days before allowing traffic.

The schematics of the Infloor particle flooring is depicted below:



Option II: Traditional Flooring System

Typically, the advantage of this system is to provide high abrasion resistance for the intended heavy traffic. Due to the presence of iron particles in the top layer, the surface is expected to be tough and thus provide very high abrasion resistance. But Infloor particle flooring, generally have a tendency to 'curl' at the panel joints due to the following reasons:

- Normally the water-cement ratio is high to achieve flowability of the mix
- Higher water content results in excessive evaporation of water from the top surface leading to displacement of iron particles (due to its weight) to the bottom surface
- Consequently it results in fine cement particles being

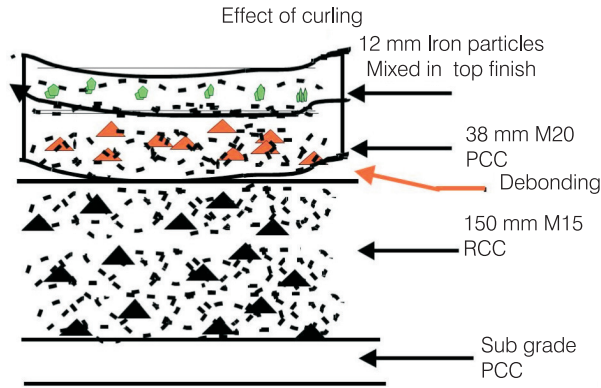
INDUSTRIAL FLOORING

carried to the top causing excessive shrinkage at the top compared to the bottom.

- This leads to stresses causing the floor slab to curl at the joints
- The resultant forces lead to de-bonding of 'wearing course' from the sub-grade

The above phenomenon can be pictorially depicted as follows:

Infloor Flooring System

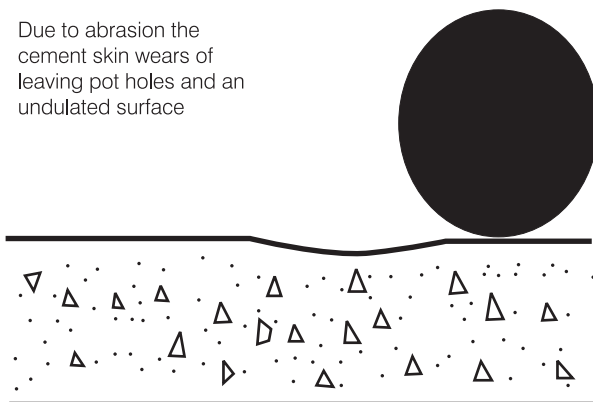


Besides, this type of floor is not suitable for areas that come in contact with water as the iron particles tend to get rusted due to the constant presence of water.

Option III: Floors broadcast with floor hardeners (metallic or non-metallic)

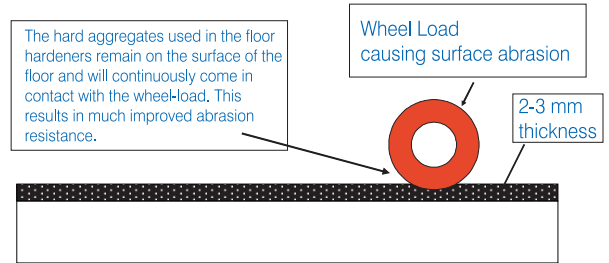
This type of floor is extremely prevalent in our country and is in vogue for the past 25 years or so. Contrary to the Infloor Particle flooring (in which iron particles are mixed in the concrete matrix itself), dry-shake floor hardeners are spread over the green concrete immediately after the concrete is poured and spread. The floor-hardeners, themselves are a mixture of cement, aggregates (quartz, carborundum or iron particles) and other additives, consumes the rising water from the green concrete, hydrates and gives a hard-wearing and dense surface. The floors, thus cast have proved to be an extremely durable and abrasion-resistant surface over a period of times. Unlike an Infloor particle floor, this does not have problem of curling and provides a fairly tough and wear-resistant surface.

Due to abrasion the cement skin wears of leaving pot holes and an undulated surface



Typical concrete floor without floor-hardeners

Dry Shake Floor Hardener System



Option IV: Floors aromoured with floor resurfacers (wet-on-wet)

Floor-resurfacer is a floor topping, combining graded hard aggregates, cement and chemical agents. The unique formulation allows the topping to be laid over new concrete (wet-on-wet method) to a thickness ranging from 5mm minimum to about 15mm. Floor-resurfacer offers good resistance to high impact and abrasion. It provides good surface durability for critical areas of a floor which cannot be closed to traffic easily or economically. Besides, integrally coloured floor-resuracer gives an excellent uniformity of the colour thus improving aesthetics. Since the floor resurfacers are used over green concrete, it becomes monolithic with the base concrete obviating any possibility of de-bonding.

In addition, liquid floor hardeners can be used in conjunction with Floor-resurfacers enhancing not only heavy-duty characteristics, but also gloss, smoothness and appearance.

Liquid hardener that chemically reacts with calcium hydroxide (also referred to as "portlandite") to produce calcium silicate hydrate (C-S-H), the same material that results from the reaction between portland cement and water, giving concrete much of its strength.

Option V: Epoxy / PU floor toppings

All the above floors that were discussed so far are of cementitious in nature and hence cannot give the following properties:

- Joint-less seamless floors
- Impermeable that do not allow oil, grease etc to permeate

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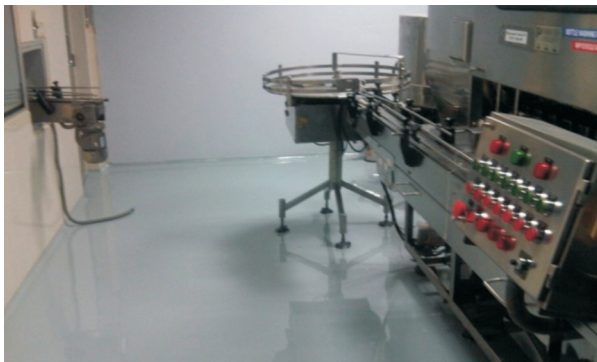
Floor re-surfacer without liquid floor-hardener

- Anti-fungal, anti-bacterial characteristics
- Chemical resistance

Typically epoxy / Pu floorings are laid from 1mm to 5mm thickness. Special floorings can be laid from 6mm to 9mm as well (such as cold storage). These floorings are executed by specialized applicators who are trained in handling these materials. The base floor being concrete, it is necessary to take care in surface preparation, joint treatment, application procedure etc.

Advantages

- Excellent aesthetic dust-proof flooring solution.
- Long-life, if properly maintained
- Gloss that increases work ambience
- Resistance to penetration of oil, grease etc
- High abrasion and impact resistance
- Seamless, jointless flooring that can resist variety of chemicals
- Ant-bacterial, anti-fungal hygiene protection
- ESD floor solutions are available for specific areas



Pharmaceutical Epoxy Flooring



Epoxy Flooring for engineering industry



Conclusions

From the above analysis, it is clear that various floorings offer different type of advantages and suffer a few shortcomings. Based on the priority of a specific requirement, the user has to decide on the suitability of specific floorings. It can safely be said that though concrete is the ideal choice for a sub-floor, it cannot offer many of the demanding requirements of a modern-day work environment such as cleanability, dust-prevention, aesthetics, chemical resistance etc. Epoxy / PU floorings offer many of the requirements stated above, but needs care in maintaining its integrity. Hopefully, this article aims to give a clarity on all these aspects. ♦

Author's Bio

B M Nagarajan is one of the three directors of Neo-crete Technologies Pvt Ltd offering value-added flooring systems for both Industrial and commercial sector. Neocrete Technologies are the pioneers in offering epoxy floors in India. He is a chemical engineer having over 36 years of work experience and can be contacted at : bm Nagarajan@gmail.com