Pot Life

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What is Pot Life?

"Pot Life" is a term that is normally used in relation to two-pack or multi-component coating systems that cure through a chemical reaction. Two-pack epoxies and most polyurethane coatings are typical examples of such systems. These systems generally consist of a base component (often called the "Part A") and a catalyst or hardener component (often called the "Part B"). When these components are mixed together a chemical reaction starts which will lead to the curing of the paint.

In practical terms the pot life is the time from combining the components of the paint to the point at which the mixed paint is no longer useable. It is sometimes also called the working time or useable life.

Pot life is often thought of as the length of time that a mixed (catalysed) coating system retains a viscosity low enough to be applied to a surface. This is not strictly true. While many two-pack coatings show an increase in viscosity as they approach and pass their pot life there are also many products (typically low-solids or water-borne products) that show little or no change in viscosity even well past their pot life.

What Happens When You Mix a Two-Pack Paint?

As soon as a two-pack or multi-component paint is mixed the chemical curing reaction begins. Molecules of base and hardener come into contact and start reacting together and the reaction normally generates some heat. When the paint is applied in a thin film any solvent or water present evaporates out of the film and the base and hardener can react completely together to form a tightly bound, high-performance coating.

If the paint is left in the can the heat of reaction is trapped in the bulk paint and accelerates the reaction. The faster reaction generates more heat that further accelerates the reaction and so on. That is why, in high solids or solventless paints, you can feel the can heat up rapidly as you approach the end of pot life and you see a rapid increase in viscosity as the polymer becomes bigger.

With a low solids or water-borne paint the solvent keeps the base and hardener resins apart so that they only react at a few points and are then prevented from forming a tight network. Typically these paints only show a slight rise in temperature and may only show a slight change in viscosity.

At some point the curing reaction will have reached a point that the paint will either have become too thick to spread or the base and hardener resins will have reacted in bulk to the point that they are unable to form a proper network when spread as a thin film. This is the true end of pot life but can only be determined by evaluating the dried paint film. So the manufacturers product datasheet is the best source of pot life data.

Pot life is normally quoted at a **specific temperature** (usually at 25°C) and for a **specific pack size**.

What affects Pot Life?

The Curing agent or Hardener

The pot life depends on the curing agent (hardener) used. Some products have both standard and fast-cure hardeners, to allow the applicator to choose the appropriate pot life.

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Volume

The smaller the volume, the easier it is to keep the mixture cool and the less heat builds up in the can. Larger packs can generate more heat, creating difficulty in temperature control. In hot weather using small kits can help manage the pot life.

Temperature

Higher temperatures speed up reactions and so reduce the pot life. The effect may vary from product to product but a 10°C rise in temperature can halve the pot life. A hot day or leaving paint in direct sunlight can substantially shorten pot life. Spray lines full of paint left laying on the ground in direct sunlight can easily reach 40-50°C reducing the pot life to ¼ or less than that normally quoted at 25°C.

Low ambient temperature helps lower the temperature of the mixture, slow the curing reaction, and hence prolongs pot life. It is a good idea to store both the base and hardener in a cool place (around 15°C prior to use. For the reaction to proceed, the mixture needs to have some heat. Typically this is 15°C, so don't cool either the A or B pack below 15°C.

The use of a power mixer at high speed may generate more shear (friction) and hence more heat in the paint resulting in a shorter pot life. The best method for mixing paint is by power mixing under low to medium speed to ensure thorough mixing without generating excess friction.

Paint Failures Due To Application After Pot Life

Not all paint systems increase markedly in viscosity after pot-life has expired, (eg low solids or waterborne paints). The problem is, however, that a coating, when applied after pot-life has expired, may look fine initially, but when the coating is cured may fail in any number of ways.

Assuming the paint was applied whilst the viscosity was still low enough to permit application, one or more of the following paint failures are likely to occur after the paint has dried:

- *Delamination of the coating due to insufficient chemical bond between coating and substrate.*
- *Seediness or grittiness of the finish due to grains of polymerised material within the mixed material*
- *Poor flow-out and poor gloss due to increased viscosity of the mixed material*
- *Poor chemical resistance*
- *Frying or wrinkling of subsequent coatings (if the coating is a primer or intermediate)*

Once left-over mixture has reached its pot life, the best thing to do is dispose of it responsibly. Do not keep any of it, and definitely **do not attempt** to **thin**, **refrigerate** or **add** more of either **base** or **catalyst** to the mix.

How can pot life be extended?

- *Store both base and hardener in a cool (not less than 15°C) place for 24 hours prior to application. Two-packs are designed to react in the 15 to 25°C range, so don't cool to below this temperature.*
- *Use a power mixer for 3 minutes at medium speed rather than at high speed or hand mixing for 7 minutes.*
- *Use smaller pack sizes*
- *Select a slower hardener (seek advice from your supplier representative).*
- *Store the paint in a cool, sheltered place.*

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Common Fallacies With Regard To Pot Life

To extend pot life, I can add plenty of extra solvent to my mix at the start.

Wrong!

Adding thinner will lower viscosity, but **will not extend pot life** in any way. Diluting your mixture may, however, mask the point at which your mixture has **exceeded** its pot life. You will also **stall polymerisation**, which will lead to other defects. If the mixture has too much thinner in it, then the reaction will not progress through to completeness to give the desired film properties. Your thinned coating may also be too low in film build, causing further problems.

Never add more solvent than you need, and never exceed the maximum quoted on the product data sheet.

I can add thinner once my mix starts to increase in viscosity, and keep painting.

Wrong!

The **longer** that material has been mixed, the **greater the polymerisation** has advanced. If your mixture starts to thicken, it has **exceeded** its pot life. If this occurs sooner than expected, then the temperature may have been higher than that quoted on the data sheet.

After pot life has been exceeded, nothing can take the mixture back to a state suitable for application.

To use material after its pot life I can add extra base, mix it up and refrigerate, then add the extra catalyst the next day.

Wrong!

All you are doing is **wasting good base and hardener** by mixing it with old material that has **polymerised** and is **no longer chemically active**. The likely results are: delamination, grittiness or seediness of the finished film or frying of subsequent coatings.

Never add new material to old material.

To get the maximum use of your product during its pot life, please contact the Dulux Protective Coatings Technical Consultant in your state.