Waterborne Paint Drying Terminology

Solvent
A solvent is a liquid or gas that dissolves a solid, liquid, or gaseous solute resulting in a solution. The most common solvent in everyday life is water.

Waterborne paint
Waterborne paints were developed as low VOC content paint alternatives to traditional paints. Traditional paints have up to 6 lbs organic solvents per gallon. Waterborne paints generally have less than 3 lbs organic solvents per gallon. Some waterborne paints have no organic solvents at all. Paint components need to be suspended in a liquid to be able to be sprayed from a spray gun. This carrier agent is mainly water in waterborne paints.

Organic solvents
Most other commonly used solvents are organic (carbon-containing) chemicals. These are called organic solvents.

Volatile Organic Compounds (VOCs)
Volatile Organic Compounds are organic solvents. VOCs are organic chemical compounds that have high enough vapor pressures under normal conditions, for example room temperature, to significantly vaporize and enter the atmosphere. Because they evaporate readily under normal conditions, they are called volatile.

Traditional paints used organic solvents to liquify paint components thereby making the paint sprayable. Traditional paints do not need additional help to flash off since organic solvents are volatile and readily evaporate from the paint. A wide range of carbon-based molecules, such as aldehydes, ketones, and other light hydrocarbons are VOCs.

The term VOC is often used in a legal or regulatory context and in such cases the precise definition is a matter of law. These definitions can be contradictory and may contain "loopholes"; e.g. exceptions, exemptions, and exclusions. The United States Environmental Protection Agency (EPA) defines a VOC as any organic compound that participates in a photoreaction; others believe this definition is very broad and vague as organics that are not volatile in the sense that they vaporize under normal conditions can be considered volatile by this EPA definition. The term may refer both to well characterized organic compounds and to mixtures of variable composition.

Flash-Off Cycle
The cycle during which waterborne paint is dried is called the flash-off cycle. Waterborne finishes need a completely different drying environment from organic solvent based finishes. Water is not volatile and it needs a more controlled environment to evaporate from the paint than organic solvent based paints do.
Flash-Off is the fifth cycle that is added to the functionality of modern, heated paint booths. The existing four cycles are: Spray, Purge, Bake, Cool Down. Flash-off works best if it is a sub-cycle of the Spray cycle. The painter can switch into the Flash-off cycle from the Spray cycle as many times as he wishes. After the Flash-off time expires, the booth is back to the Spray cycle. The painter can either apply another coat of paint or he can switch the booth into the Bake cycle.

**Dry Cycle**
Same as Flash-Off.

**Bake Cycle**
The cycle during which organic solvents are removed from non waterborne paints through elevating the air temperature of the spray area to about 120F-180F. Baking is the technique of prolonged heating through convection.

**Convection**
Convection in our industry means that we heat the painted object by moving hot air around the object. The heat is transferred from the air to the object. This is different from, for example, curing the paint with an infrared lamp. The infrared lamp heats the object by radiation not by convection. Infrared heating is not considered baking.

The reason why convection is important for us is the following. Since we transfer heat from an air flow to an object through convection, the more efficient we can make the heat transfer from the air to the object, the better our system will work. We need to understand how air flows around an object in order to eliminate possible problems in transferring heat from the air to the object.

**Laminar Air Flow**
Smooth air flow. The absence of turbulence. Spray booth airflow is designed to be smooth. We don’t want turbulence while the painter is spraying a car.

**Boundary Layer**
The slow moving layer of air on the surface of an object in laminar air flow.

**Boundary Layer Implications for the Bake Cycle**
The boundary layer will insulate the object from the air flow that was trying to heat the object. If we break up the boundary layer by turbulence, we will have efficient heat transfer between the hot air in a spray booth oven and a car.

**Boundary Layer Implications for the Flash-Off Cycle**
The car is in the smooth air flow of the spray booth. As the paint dries water vapor exits from the paint into the boundary layer. The boundary layer will saturate with water vapor and prevent the rest of the water molecules from coming out of the paint. Since the boundary layer barely moves, it will insulate the wet paint from the lower relative humidity spray booth air. If we break up the boundary layer through turbulence, we can deliver dry air onto the wet paint to maintain the proper rate of drying.
**Cure Cycle**
Same as the Bake Cycle. Curing is a term that refers to the toughening or hardening of a polymer material by cross-linking of polymer chains, brought about by chemical additives or heat.

**Polymerization**
Polymerization is the process of cross linking.

**Turbulence Creation Devices**
Devices designed to create turbulence on the surfaces of painted objects. The purpose of these devices is to prevent the formation of the boundary layer and to make both waterborne and organic solvent borne paint drying more efficient.

**Organic Solvent Borne Paint Implications**
Turbulence makes the heat transfer from the air to the object much more efficient. You can measure the quicker metal temperature rise of the object during the Bake Cycle when you create turbulence on the surface of the painted object.

**Waterborne Paint Implications**
Turbulence delivers low relative humidity air onto the surface of the object to maintain the correct drying rate.

**Directional Turbulence**
Turbulence that travels in the direction of the air flow. Pulsation is the best way to create directional turbulence.

**Air Accelerator or Air Mover**
Air accelerators do what their name implies. They accelerate airflow. They are not specifically designed to create turbulence, but they incidentally do create some. Hand held or tree mounted air accelerators are designed to deliver more air onto a repair area. They are not a complete solution; they are supposed to only accelerate airflow on a part of the car.

**One Component Paint (1K Paint)**
Single component paint. This means there is no catalyst in the paint. There are no chemical reactions taking place when the paint dries. The paint will be dry when the solvents are removed.

**Air Quality Management District (AQMD)**
The South Coast AQMD is the air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside and San Bernardino counties. This area of 10,743 square miles is home to over 16 million people - about half the population of the whole state of California. It is the second most populated urban area in the United States and one of the smoggiest.

AQMD is responsible for controlling emissions primarily from stationary sources of air pollution. These can include anything from large power plants and refineries to the corner gas station. There are about 28,000 such businesses operating under AQMD permits. Many consumer products are also considered
stationary sources; these include house paint, furniture varnish, and thousands of products containing solvents that evaporate into the air. About 23% of this area’s ozone-forming air pollution comes from stationary sources, both businesses and residences. The other 77% comes from mobile sources—mainly cars, trucks and buses, but also construction equipment, ships, trains and airplanes. Emission standards for mobile sources are established by state or federal agencies, such as the California Air Resources Board and the U.S. Environmental Protection Agency, rather than by local agencies such as the AQMD.