A Dry Car

Many Steps to Get There

By Darryl and Cheryl Dobie

Car wash dryers are generally the final mechanical component in the wash process. Because of this position, the dryer is commonly regarded as either the entire problem or the perfect solution. While it is true that conditions specific to the dryer, such as outlet angle/placement, ductwork configuration, or the addition of heat may influence the outcome, they are only part of the total equation. Any dryer's performance can be enhanced or impeded by the process that precedes the dryer.

Ideally, vehicle-body styles would be uniform and remain unchanged for a number of years. Dimensions and contour angles would be the same for each vehicle. Crevices, molding and accessories would be located in the same position and be of the same width and depth. In this ideal world, facilities, equipment, and chemicals could be designed to achieve a perfectly clean, dry car with every wash. Of course, this scenario would only be possible in a car manufacturing plant producing limited models. Instead, the wash process must accommodate a wide variety of vehicles and still be adjustable to meet specific needs. Each phase in the process, as discussed here, is an important part of the formula for a clean, dry car delivered in a timely, cost-effective manner to a satisfied customer.

SOAP

Soap is first used in the prep area to remove excessive buildup of dirt and pre-treat areas that will want for coverage by standard equipment and chemicals. Soap is one of a class of chemical substances called surfactants. The word surfactant is a contraction of "surface active agents." Generally speaking, surfactants consist of molecules that have both hydrophilic (water-binding) properties and hydrophobic (water-repellent) properties. The hydrophilic part allows the hydrophobic part to bind with other hydrophobic substances, such as the dirt on the surface that is being cleaned. Therefore, the vehicle surface must be sufficiently wetted, prior to the soap application, in order for the soap to begin its work. Adequate dwell time is then required to allow surface grime adhesion to the soap's hydrophobic substances and become encapsulated within the droplets of water. The dirt and grime, once suspended away from the surface, is ready to be scrubbed off either by friction or pressure, and washed away.

RINSE

Soap film (approximately 98 percent water and 2 percent surfactant) may remain on the surface after the obvious dirt and grime has been removed. This film is a very thin layer — typically only a few microns (millionths of a meter) in thickness. In order to continue a successful wash process, soap film must be completely removed during the rinse process. Failure to do so allows the viscous film to coat the vehicle, preventing wax and drying agents from reaching the surface. Generally, a series of rinse applications is required to successfully complete this portion of the process.

After thorough rinsing, polish wax, if opted for by the customer, is applied. Polish wax provides gloss and protects the surface from everyday harmful elements. Adequate flooding of clean rinse water is then required to remove the excessive volumes of foamy, showy waxes, which are the trend today. Excess polish wax, left trapped in crevices and contours, may run out and create streaks and spots.

"Rain" arches, while efficiently flooding the vehicle surface, penetrate these crevices and remove leftover residue — without the splashback and subsequent mist created by high-pressure rinse arches. This method of application becomes more valuable as the vehicle approaches the drying process.

Application of treated rinse water is critical prior to the vehicle entering the drying phase. Introducing a rinse aid (wax) breaks down the surface tension of the water, changing the characteristic of the water from "sheets" to beads. Establishing a bead is vital because beads of water are less weighty, have less surface tension, and therefore are easier for the drying system to remove. Water still possessing sheeting qualities tends to slide around and remain on the vehicle surface rather than leaving the surface. One soap manufacturer emphasized the importance of establishing a bead through the question in this simple scenario: Using a household broom, is it easier to sweep away a brick in its whole form, or is it easier to sweep away a brick broken into many tiny pieces? This same principle applies to water.

DRIP SPACE

Drip space is an important factor in reaching the ultimate goal of a "dry" car. A water-repellent surface — such as a freshly waxed car — is hydrophobic. When the surface of water (hydrophilic) comes into contact with a hydrophobic surface, which it considers undesirable material, water will thrash about trying to get away from that undesirable material. Drip space acts as a "safe zone" to allow the occurrence of the natural reaction between these two opposing, however sequential steps.

EQUIPMENT LAYOUT

Provided the chemicals being applied are metered in adequate amounts, proper spacing of the distribution system allows thorough application of these chemicals. Each chemical has an optimal dwell time, which is the amount of time required for the chemical to complete its work. Should the chemical not be allowed its recommended dwell time, subsequent step(s) in the sequence will be impaired.

Rinse arches located too close to the dryer will increase splashback and tunnel mist in the area dedicated to the drying process. Prevailing winds from entrance to exit may also cause misted water or splash to be driven into the drying area, pulled into the dryers and deposited back onto the vehicle. To expect the dryer to overcome shortfalls in preceding steps in the wash sequence is to expect the dryer to complete tasks it simply was not designed to do.

CONVEYOR SPEED

Although sometimes overlooked, conveyor speed plays an important role in the car wash process. Running the conveyor as slow as is reasonable delivers a cleaner, drier car. It allows thorough cleaning, rinsing, and drying by serving as an adjustment to achieve complete vehicle coverage and optimal chemical dwell time. Rushing through any phase of the process ultimately affects the quality of the final product.

THE DRYER

Only now, after reviewing the various elements considered necessary to achieve a clean, dryer-friendly car, is it time to discuss the basics of the mechanical drying methods utilized in the car wash industry.

System Effect

In general, fan impellers work through the creation of a pressure differential, in that air moves from a higher-pressure environment to a lower-pressure environment. System effect is defined as loss of pressure resulting from restrictions or conditions within the system (ductwork design), affecting fan performance. System effect, which is sometimes difficult to quantify, robs the air-moving device of efficiency and increases noise and vibration. Different fan types, as discussed below, require dissimilar air delivery designs to achieve the required results.

Temperature and Elevation

Air density is a function of elevation and temperature and both of these variables affect fan air-performance. A fan operating at higher temperature and elevation will move the same volume of air as it would at lower temperatures and elevation, but with less total pressure and less horsepower. Humidity can impede the drying process by preventing the partial evaporation of water into the atmosphere.

Today, some operators have chosen to add heat to their drying process. Science tells us that heat will increase the evaporative rate of water and warm the tunnel, which potentially benefits the wash process. However, while heat may evaporate water droplets, any chemical residue encapsulated within the droplets does not evaporate, thus leaving dried spots on the surface of the vehicle. Additionally, air drying utility costs may already account for a significant portion of the operating budget and attempting to heat a large, open-ended tunnel may not prove feasible. An operator must first research local utility costs, consider climate, assess the total system, and, most importantly, be aware of what pleases the customer before completing this upgrade.

Fans

The two general types of fans are axial-flow and centrifugal.

In the **axial-flow fan,** air passes through the fan parallel to the drive shaft. An axial-flow fan is suitable for a larger flow rate (cubic feet per minute or CFM) with relatively small pressure gain. The effective progress of the air is straight through the impeller at a constant distance from the axis. To accommodate the larger volume of air exiting the apparatus, the outlets are larger than those of a centrifugal system. Since air essentially flows directly through from inlet to outlet, increasing the size of the inlet will, to the extent of the fan and motor capabilities, allow the size of the outlet to also be increased. Configuring the outlets too small may result in a fan "stall," where the backpressure has reached its maximum and the fan simply does not produce air with every rotation. These fans are widely used for providing the required airflow in heat and mass transfer operations.

Centrifugal fans are often called "squirrel cage" fans. They operate on the principle of "throwing" air away from the blade tips. The air is led through an inlet pipe to the center of the impeller, which forces it radially (making a right angle turn) outward into the volute from which it flows into the discharge pipe. The blades can be forward curved, straight or backward curved (inclined). A centrifugal fan has a comparatively smaller flow rate with a larger pressure rise and, because of this pressure rise, the likelihood of stress fractures and fan failures is increased. Improper sizing of ductwork or outlet assemblies, configured in an effort to achieve specific results, may increase backpressure and therefore lead to fan or motor failures.

Horsepower/rpm

Increasing horsepower without increasing rpm may not necessarily improve performance. Motor horsepower is determined by the amps required to turn the fan at a given speed on a pre-determined voltage — 1800 rpm or 3600 rpm are standard. The performance of a fan depends on the size, shape, and speed of the impeller. Factors like cost optimization, power rating, and noise levels govern the selection of a fan suitable for a given application. Two measurements are commonly used to describe the physical characteristics of a fan: blade diameter and motor horsepower. While these are useful measures, without the proper combination of airflow rate and static pressure capabilities, they only give a very general idea of fan capacity.

Airflow

Airflow broadens as it leaves ductwork constrictions. It follows a straight-line path, however. A volume of pressurized air, aimed at the top of a vehicle, flows along the surface to the widest point of that vehicle. It is at this point that the straight-line path of airflow is interrupted and deflected away from the lower, tapered portion of the vehicle. Consequently, to achieve an effective dry, airflow must also be directed at vertical surfaces in a slightly downward manner. Stripping moisture first from the top portion of the vehicle, followed by the sides, conforms to natural gravitational forces. (It is important to note that proper direction of airflow and/or spacing of components within the drying system itself is essential to reduce turbulence.)

Pressure/Volume

Neither pressure alone nor volume alone can effectively move fluid. The correct combination of both pressure and volume provides complete vehicle coverage with adequate force to remove properly treated rinse water. Only a small amount of pressure is necessary to break the surface tension allowing the volume, along with its accompanying weight, to effectively move the debris/water. This concept can be understood easily using the following example: Utilizing a zero-degree nozzle, attempt to wash debris from a driveway. The narrow nozzle delivers water at a high pressure, but volume is reduced, cleaning only a narrow path and is not effective in pushing a quantity of debris forward. Adjusting the nozzle to a wider path increases the volume of water (and thereby the weight). Although the pressure is slightly decreased, the increased weight of the water, along with the increased path width, effectively carries more debris forward.

One standard procedure does not exist for achieving a clean, dry car. Regional characteristics, customer base, and costs influence operator choices, and these choices must be cohesive elements working toward a common goal.

Darryl and Cheryl Dobie are with Broomfield, CO-based Aerodry Systems LLC. You can visit the company's web site at www.aerodrysystems.com.