Car Wash 101

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Water Quality is the culprit in 90% of cleaning issues

- **Water Hardness:** Hard water is any water containing an appreciable quantity of dissolved minerals (calcium, magnesium and other cations).
    - Hard water can be softened (have its minerals removed) by treating it with lime or by passing it over an ion exchange resin. The ion exchange resins are complex sodium salts. Water flows over the resin surface, dissolving the sodium. The calcium, magnesium, and other cations precipitate onto the resin surface. Sodium goes into the water, but the other cations stay with the resin. Soft water is treated water in which the only cation (positively charged ion) is sodium.
    - Extremely hard water may shorten the life of plumbing and lessen the effectiveness of certain cleaning agents.

An ***ion*** is an atom or molecule which has lost or gained one or more electrons, making it positively or negatively charged.

An ***anion*** is a negatively charged ion, which has more electrons in its electron shells than it has protons in its nuclei. Examples are chloride (Cl^-), sulfide (S^{2-}), and oxide (O^{2-}).

A ***cation*** is a positively-charged ion, which has fewer electrons than protons. Examples are sodium (Na^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), and ferrous iron (Fe^{2+}).

- A general rule of thumb is that if your water hardness is 3 grains per gallon or greater, a water softener will pay for itself. For frictionless systems, 0 grains per gallon is recommended.

Grains Per Gallon	Parts per million or milligrams per liter	Description
Less than 1.0	Less than 17.1	Soft
1.0 to 3.5	17.1 to 60	Slightly hard
3.5 to 7.0	60 to 120	Moderately hard
7.0 to 10.5	120 to 180	Hard
10.5 and higher	180 and higher	Very hard

- **Damage to equipment and increased energy costs:** When hard water is heated, the carbonates precipitate out of solution, forming scale in pipes and water heaters. In addition to narrowing and potentially clogging the pipes, scale prevents efficient heat transfer, so a water heater with scale will have to use a lot of energy to give you hot water.

- According to the American Society of Plumbing Engineers, 1/16 in. of scale can increase energy consumption by 11%. Similarly, the Water Quality Research

Council claims that it costs 29% more to heat untreated water.

- Chemicals perform better with soft water. These metal ions in hard water interfere with the cleaning ability of detergents. The metal ions act like dirt and "use up" the surfactants, making them unavailable to act on the surface we want to clean. (See also, “Chelating Agents”)

- For every grain of water hardness, detergent use increases 2% to 4% per 1,000 gal of water used.

Chemical Savings using Soft Water	
Original Water Hardness	**Approximate Savings when Softened**
2-5 grains	15%
5-10 grains	25%
10-15 grains	35%
15-20 grains	45%
20+ grains	50%

- **Total Dissolved Solids** (TDS) are hard water minerals suspended in your water. TDS are the total amount of mobile charged ions, including salts, minerals and metals, in a given volume of water, expressed in units of milligrams per unit volume of water (mg/L). They are also referred to as parts per million (ppm).

  - Spot-free water should have a TDS count below 20 parts per million. This may occur naturally or can be achieved through pro-cessing. The overwhelming ma-jority of spot-free systems currently in use are reverse osmosis. A TDS Meter can measure the contaminants in your water and indicate how well your water purification system is working.

Contact your Chemloc representative for a water quality evaluation!

- In winter, wash **water temperature** should be increased to remove the potential ice, snow, and sludge. In summer, cool water may be necessary as the car surface temperature may reach up to 120 degrees Fahrenheit. Increased detergent activity from the increase in temperature may damage the surface of the vehicle.

  - Check the water (from the presoak arch, for example) and maintain temperature around 110 degrees. Warm or hot water melts fats and oils so that it is easier for the soap or detergent to dissolve the soil and pull it away into the rinse water.

  - It is important to consider both the vehicle surface temperature and wash water temperature. Ambient temperature for the tunnel is ideal.

Common Equipment failures are foot valves, injector tips, and spray nozzles

- Perform a **titration**
  - ***Too low?*** – failure in foot valve or blockage at an injection tip or spray nozzle
  - ***Too high?*** – injector tip or spray nozzle is worn and needs replacement
- Perform **Draw Test**
  - ***Too much product used?*** - injector tip or spray nozzle is worn and needs replacement
  - ***Too little product used?*** - failure in foot valve or blockage at injection tip or spray nozzle
- **Foot valve**
  - Filters particles to prevent clogging of draw tube lines
  - Maintains constant suction on draw line
  - Prevents backflow of chemical into drum
  - Test for proper function – Remove draw line from drum; If chemical empties out of the line, replace foot valve
- **Injector tips**
  - Subject to clogging as openings very small
  - Carefully Remove tip and inspect for obstruction or damage, replace if necessary
- **Spray nozzles**
  - Create direction, spray and pressure within system
  - Replacement of nozzles is necessary when loss of pressure negatively impacts chemical coverage

Nozzle Size	Orifice Diam. (Inches)	40 PSI	100 PSI	250 PSI	500 PSI	600 PSI	700 PSI	800 PSI	1000 PSI	1200 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	3500 PSI	4000 PSI
02	0.034	0.20	0.32	0.50	0.71	0.77	0.80	0.89	1.0	1.1	1.2	1.4	1.6	1.7	1.9	2.0
04	0.052	0.40	0.63	1.00	1.40	1.60	1.70	1.80	2.0	2.2	2.5	2.8	3.1	3.5	3.8	4.0
4.5	0.055	0.45	0.71	1.10	1.50	1.70	1.90	2.00	2.2	2.4	2.8	3.0	3.6	3.9	4.3	4.5
05	0.057	0.50	0.79	1.30	1.80	1.90	2.10	2.20	2.5	2.8	3.1	3.6	4.0	4.4	4.7	5.0
5.5	0.06	0.55	0.87	1.40	1.90	2.10	2.30	2.50	2.8	3.0	3.4	3.8	4.4	4.8	5.2	5.5
06	0.062	0.60	0.95	1.50	2.10	2.30	2.50	2.70	3.0	3.2	3.7	4.2	4.8	5.2	5.6	6.0
6.5	0.064	0.65	1.00	1.70	2.30	2.50	2.70	2.90	3.3	3.6	4.0	4.6	5.2	5.7	6.0	6.5
07	0.067	0.70	1.10	1.80	2.50	2.70	2.90	3.10	3.5	3.8	4.3	5.0	5.6	6.1	6.6	7.0
7.5	0.07	0.75	1.20	1.90	2.70	2.90	3.20	3.40	3.8	4.1	4.6	5.3	6.0	6.5	7.0	7.5
08	0.072	0.80	1.30	2.00	2.80	3.10	3.40	3.60	4.0	4.4	5.0	5.6	6.2	7.0	7.5	8.0
8.5	0.074	0.85	1.30	2.20	3.00	3.30	3.60	3.80	4.3	4.6	5.3	6.0	6.7	7.4	8.0	8.5
09	0.076	0.90	1.40	2.30	3.20	3.50	3.80	4.00	4.8	5.0	5.5	6.4	7.1	7.8	8.5	9.0
9.5	0.078	0.95	1.50	2.40	3.40	3.70	4.00	4.30	4.8	5.2	5.8	6.8	7.6	8.3	9.0	9.5
10	0.08	1.00	1.60	2.50	3.50	3.90	4.20	4.50	5.0	5.4	6.1	7.0	8.0	8.7	9.4	10.0
12	0.087	1.20	1.90	3.00	4.20	4.60	5.00	5.40	6.0	6.4	7.3	8.4	9.5	10.4	11.2	12.0
15	0.094	1.50	2.40	3.80	5.30	5.80	6.40	6.80	7.5	8.2	9.2	10.6	12.0	12.9	14.0	15.0
20	0.109	2.00	3.20	5.00	7.10	7.80	8.40	9.00	10.0	10.8	12.2	14.2	16.0	17.4	18.8	20.0
30	1.41	3.00	4.70	7.50	10.60	11.60	12.80	13.60	15.0	16.4	18.4	21.2	24.0	26.0	28.0	30.0
40	1.56	4.00	6.30	10.00	14.20	15.60	16.80	18.00	20.0	21.6	24.4	28.4	32.0	34.8	37.6	40.0

Interior numbers are GPM (Gallons per Minute)

- How to determine Nozzle size:
  - Calculate GPM and PSI to determine nozzle size
  - (Ex. 1200 PSI at 3.8 GPM = nozzle size of 07, see above chart)
- After determining nozzle size, choose a degree of spray pattern:
  - 15 = 15° (narrow)
  - 25 = 25° (medium)
  - 40 = 40° (wide)
- Typical available spray patterns: 05, 15, 25, 40, 50, 65, 80
  - Degree of spray does not affect nozzle volume

For specific information on your spray equipment and nozzles, contact your supplier

Equipment

- A **Presoak** is a one or two step cleaning process with two pH levels for different types of dirt. The low pH cleans chrome and glass, while the high pH cleans road film and paint surfaces. This process covers your vehicle with fast acting detergents that break down dirt and grime. This pre-soak process is specially formulated soap to gently loosen stubborn road film. Typically a low pH presoak is followed by a high pH presoak. A dwell time of 25 to 30 seconds for each soak is ideal.

Alkali/High pH/Alkaline Any substance that has a pH greater than 7 (neutral). Any chemical known as alkalis are corrosive.

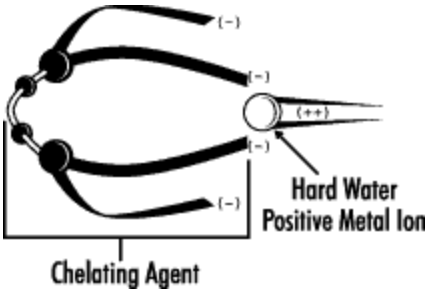
Acid/Low pH/Acidic A chemical compound that contains one or more hydrogen ions that will liberate hydrogen gas on contact with certain metals and has a pH of less than 7 (neutral), and is very active chemically.

- **Soaps/detergents** – Remove Dirt from a Soiled Surface
  - Detergents and soaps are used for cleaning because pure water can't remove oily, organic soiling.
  - Soap cleans by acting as an emulsifier. Basically, soap allows oil and water to mix so that oily grime can be removed during rinsing.
  - Detergents were developed in response to the shortage of the animal and vegetable fats used to make soap during World War I and World War II.
    - Detergents are primarily surfactants, which could be produced easily from petrochemicals. **Surfactants** (surface active agents) lower the surface tension of water, essentially making it 'wetter' so that it is less likely to stick to itself and more likely to interact with oil and grease.
    - Detergents are similar to soap, but they are less likely to form films (soap scum) and are not as affected by the presence of minerals in water (hard water).
  - Like soaps, detergents have hydrophobic or water-hating molecular chains and hydrophilic or water-loving components. The **hydrophobic** hydrocarbons are repelled by water, but are attracted to oil and grease. The **hydrophilic** end of the same molecule means that one end of the molecule will be attracted to water, while the other side is binding to oil.
  - Neither detergents nor soap accomplish anything except binding to the soil until some mechanical energy or agitation is added into the equation. Rinsing washes the detergent and soil away.

- **Chelating Agents** – Surround unwanted Metal Ions

    - Chelating agents, (pronounced keelating from the Greek word claw) combines itself with disruptive metal ions in the water. The metal ions are surrounded by the claw-like chelating agent which alters the electronic charge of the metal ions from positive to negative (see diagram below.)

    - This makes it impossible for the metal ions to be precipitated with the surfactants. Thus, chelated metal ions remain tied up in solution in a harmless state where they will not use up the surfactants.



- Some common chelating agents used in industrial cleaning compounds include phosphates, EDTA (ethylene diamine tetra acetate), sodium citrate, and zeolite compounds.

- The chelating process, though very effective, is not always necessary and adds to the cost of formulating detergents. Builders are often a good alternative.

- **Builders** - softening, buffering, and emulsifying.

    - Builders are added to a cleaning compound to upgrade and protect the cleaning efficiency of the surfactant(s).

    - Builders **soften water** by deactivating hardness minerals (metal ions like calcium and magnesium. They do this through one of two ways:

        - **Sequestration** - holding metal ions in solution.

        - **Precipitation** - removing metal ions from solution as insoluble materials.

    - Builders, in addition to softening, provide a desirable level of alkalinity (increase pH), which aids in cleaning. They also act as **buffers** to maintain proper alkalinity in wash water.

    - Builders help **emulsify** oily and greasy soil by breaking it up into tiny globules. Many builders will actually peptize or suspend loosened dirt and keep it from settling back on the cleaned surface.

    - Three of the most common builders used in today's heavy-duty detergents are:

        1. **Phosphates**, usually sodium tripolyphosphate (STPP), have been used as builders extensively in heavy-duty industrial detergents. They combine with hardness minerals to form a soluble complex which is removed with the wash water. They also sequester dissolved iron and manganese which can interfere with detergency.

        2. **Sodium carbonate (soda ash)** is used as a builder but can only soften water through precipitation. Precipitated calcium and magnesium particles can build up on surfaces, especially clothing, and therefore sodium carbonate is not used in laundry detergents.

3. **Sodium silicate** serves as a builder in some detergents when used in high concentrations. When used in lower concentrations, it inhibits corrosion and adds crispness to detergent granules.

- A **Solvent** is a substance, usually a liquid, capable of dissolving another substance.
  - In addition to water, other chemical solvents are often added to cleaners to boost performance. Compounds such as 2-Butoxyethanol (butyl), isopropyl alcohol (rubbing alcohol) and d-Limonene are all considered solvents. Their main function is to liquefy grease and oils or dissolve solid soil into very small particles so surfactants can more readily perform their function.

  - During the winter months, organic solvents work to keep solutions from freezing because it acts to lower the temperature at which the mixture would normally freeze.

  - All **Sealants & Drying Agents** are based on the same chemical principal. Ingredients are formulated that will adhere to the vehicle, and make it repel water. The actual ingredients may vary from product to product, but the principal is the same.

  - The purpose of a drying agent is to quickly make the surface of the vehicle repel water so it will run off the surface, leaving the car dry.

  - The **efficacy of drying agents** is determined by how well the detergents are rinsed off the car, temperature of the surface and delivery water, drip space length/time, wind or blower action, and the cleanliness of the surface.

  - A very low viscosity mineral seal oil may be used as a car wash drying agent.

  - Sealant products are similar to drying agents in that they too should make water run off the surface, but they should also do more such as contain ultra violet light protection and special brighteners and provide extra protection for the surface.

- **pH Testing vs. Alkalinity Titration Testing**

  - Measuring the strength of alkalinity in a solution is called the "titration of the solution", and a more accurate way to **measure soap cleaning power**.

  Simply determining the pH of your solution is not the same as measuring total alkalinity.

  - The difference between one measure on the pH scale, say from 8 to 9, will show *10 times* as much alkaline charge! To get that much change, you would have to add *several* measures of product (liquid or powder).

  - So, if you add more product into a soap solution, you will get more “power" from the soap. But remember, this may not change the pH of that solution by any measurable amount.

  - The output is calculated by measuring a specified amount of a solution, coloring the solution with a dye, and then adding drops of acid to change the color of the solution. Titration of the solution is measured by the number of drops it requires to change the color of the sample. If it takes 10 drops to change the color, you then have a reference point to work with. Your mission is to find out where your car wash performs the best and make sure you maintain that reference point. It is important to test your soap solution mixture on a regular basis.

- **Importance of Water Temperature**

  All physical and chemical reactions are temperature dependent. This simply means the higher the water temperature the faster and better the cleaning. There are limits, therefore, keep the temperature under 150 degrees Fahrenheit. Here are some factors that are temperature dependent:

  - Soils and soil deposits are more soluble at elevated temperatures.
  - The surface active agents in detergents are more efficient
  - Emulsification of dirt, oil and combinations of these types of soils is much faster at higher temperatures.
  - The higher pH builders in detergents break up oils much faster in water over 140 degrees Fahrenheit.
  - Solvents present in liquid detergents remove and hold soils in suspension faster at elevated temperatures.

  In summary, the higher the water temperature, the faster water, soil and chemical molecules move in the solution. Hot water simply means better, faster, and stronger cleaning power.

- **Is the water soft?**

  Hard water affects the performance of wash products

- **Has there been a change in the temperature of the soap mixture?**

  Cold water reduces the effectiveness of soap and waxes

- **Is the dilution tip or foot valve plugged?**
- **Is the Hydrominder or Metering device functioning properly?**
- **Is there a problem with the consistency of the water pressure in the line feeding the hydrominder?**

  Low water pressure will dramatically increase the dilution, decreasing the concentration of the soap mixture

- **Has the length of the tube running from the source drum been lengthened?**

  An increase in distance creates more resistance which increases dilution, weakening the soap mixture

- **For automatics, did the dwell time for the presoak get changed?**
- **Soil Type Issue –** A flash change in soil composition from warm rains after a long dry period
- **Spots on car?**
  - Oily spots on vehicle surface –
    - Too much drying agent applied to vehicle
    - Incomplete rinse by spot-free water
  - Powdery spots on vehicle surface
    - Water Quality – hard water leaves white spots after drying due to mineral content in water. Test water and adjust or replace water softener.
    - Too much soap being used or not properly rinsed will react with drying agent and may form a powdery white residue.