

# Best Practices Guide for Soluble Support Removal

*A Practical Guide to Fast and Efficient Removal of Soluble Supports for Stratasys FDM and PolyJet Parts*

Prepared by the Technical Support Team at PADT, Inc.

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# Introduction

Fused Deposition Modeling (FDM) and PolyJet Technologies from Stratasys offer a broad range of well-tested polymer materials. This wide range of material choices enables the creation of durable and accurate parts that meet the demanding needs of manufacturing prototyping, tooling, and production. This has made Stratasys, and their technologies, one of the most popular Additive Manufacturing (AM) solutions worldwide.

An additional advantage of Stratasys AM solutions are the available support options. The FDM and PolyJet processes require support material under overhanging geometry. In many other processes, the supports are made from the same base material as the part being created. Those supports must be cut or machined away, a lengthy and expensive task. Stratasys solves this problem with material that breaks away from the desired part or that can be dissolved in water.

This Best Practices Guide focuses on the effective and efficient removal of soluble supports. It covers the material options available from Stratasys, safety guidelines, and how SCA systems remove the material, along with tips and hints for users.

## Frequently Asked Questions

1. *How do I know when to change the solution?*

The most accurate way to know when to change the solution is to check pH and change out the solution when the pH drops below 11.5.

If parts turn brown, have a sticky residue, or if the solution is very cloudy, it is time to change the solution.

2. *For how many parts or amount of time does the solution stay good?*

Replace the solution after removing 2.4 lbs. in the SCA-1200HT and 5 lbs. of support material in the SCA 3600.

3. *Can I run the SCA overnight or continuously without any safety issues?*

Yes. All SCA systems have been tested for continuous use at temperature and have been designed to include safety features that allow unattended operation.

4. *How do I dispose of the solution?*

Every location is different. Consult the Material Safety Sheet that came with the concentrate used in the solution or the local authorities to determine the best method.

5. *How much ventilation is required and are there any toxic vapors they should be concerned about.*

Please contact PADT to obtain the results of studies on ventilation for working with soluble support removal concentrates.

6. *What is the best way to fill an SCA tank with clean water?*

If possible, locate the SCA near a water source and use a hose that is firmly held in the SCA tank to fill the tank. If that is not available, then a portable water tank that includes a siphon or small pump is recommended.

7. *What is the best way to drain an SCA tank?*

We recommend purchasing a gray water tote. This is a wheeled tank used with RVs and it is perfect for SCA draining.

# Soluble Support Material and Solutions

There are two families of material that come into play for Stratasys soluble supports. The first is the support material itself. This is what the printer lays down to hold up and reinforce the build material. It is designed to work the same way as the build material but has added chemicals that cause the material to dissolve in water. The second material family is chemical detergents that speed the dissolving process by raising the pH of the water.

## SUPPORT MATERIALS

Stratasys provides support material for both the FDM and Polyjet product line that dissolves in water as described above. Each material is designed to work with a given build material.

Summary of Stratasys Support and Build Materials		
Technology	Stratasys Material Name	Build Materials
FDM	SR-30	ABS Based Polymers: ABS-ESD7, ABSi, ABS-M30, ABS-M30i, ABS-Plus ASA Polymer: ASA
	SR-35	ABS Based Polymers: ABS-ESD7, ABS-M30, ABS-M30i ASA Polymer: ASA
	SR-100	Polycarbonate Based Polymers: PC, PC-ABS, PC-ISO
	SR-110	Nylon Based Polymers: Nylon 6, Nylon 12, Nylon 12 CF
PolyJet	SUP706	All Stratasys PolyJet Resins

Note: Higher temperature FDM materials are not compatible with soluble support material, and not all Stratasys FDM systems can use soluble support material.

For these situations, a support material called breakaway, or BASS, is available. Do not try to remove breakaway support material in an SCA.

Some PolyJet systems utilize a support material that is not water soluble, SUP705. Do not try to remove SUP705 material in an SCA.

## **WATERWORKS REMOVAL CONCENTRATE**

The most common additive for speeding the support removal process is WaterWorks concentrated solution. This is an alkaline chemical consisting of Sodium Carbonate, Sodium Hydroxide along with Sodium Lauryl Sulfate, and Sodium Metasilicate. The Sodium Carbonate and Sodium Hydroxide react with the ester groups so the water can get in and do its job. The other two ingredients help with PolyJet support removal.

The current part number for the concentrate is P400SC. And it can be purchased from the same supplier that provides customers with other Stratasys materials. The concentrate is shipped in 2.1 lb. bottles packed in cases of 12. It is recommended that one 2.1 lb. bottle be used each time the SCA-1200HT is filled and two 2.1 lb. bottles are added to water for the SCA 3600.

Note: WaterWorks concentrate bottles can only be shipped by ground.

Once mixed with water in the SCA tank (see below for the proper ratios), the pH level is around 12.6. For reference, laundry detergent is 11-12 and dishwasher detergent 10-11.

WaterWorks concentrate can be added to SCA tanks for both FDM and Polyjet support material removal. For Polyjet support removal, PADT has found that the ratio recommended for FDM support removal works just as well for Polyjet support removal.

Note: FDM and Polyjet parts should not be processed together or in the same cleaning solution. If only one SCA is available, fresh cleaning solution is required when switching between the two technologies.

## **ECOWORKS REMOVAL CONCENTRATE**

Stratasys also offers a less alkaline material that does not include Sodium Hydroxide and comes in a tablet form. At a lower pH of 10, it offers a user- and eco-friendly solution for customers who would prefer that approach or who have company or government requirements that preclude the use of WaterWorks.

Note: ECOWORKS cleaning agent only works effectively with SR30 support material.

## TECHNIPRINT SUPPORT CLEANER CONCENTRATE

A third party, Technic Inc., offers an alternative support removal concentrate that works with the SCA product family to remove FDM soluble supports (SR-30, SR-100, and SR-110). PADT's testing with the SCA-1200HT and SCA 3600 shows that on average, it cleans around twice as fast as other concentrates and depending on geometry, can clean up to four times as fast. Another advantage of the material is that it changes from blue to white or brown as the concentrate is consumed, giving a clear indication as to when to change out the cleaning solution.

The concentrate is available from the manufacturer ([www.techniprint-technic.com](http://www.techniprint-technic.com)) in 1 quart, 5 gallon, and 55 gallon containers. They also offer a TechniPrint Eco Reclaim Agent that pulls the dissolved support material out of the solution into an easily disposable solid waste and a low pH liquid.

## DETERGENTS

A variety of off-the-shelf consumer and industrial detergents that produce alkaline solution have been used with a variety of support removal devices.

### PADT DOES NOT RECOMMEND THE USE OF DETERGENTS IN SCA SYSTEMS

Unlike the recommended concentrates, these chemicals are not formulated for the support materials used in Stratasys additive manufacturing systems. They also leave significant residue on parts and machines, and can create suds during use that may overflow.

## SODIUM HYDROXIDE AND SODIUM METASILICATE FOR POLYJET

Stratasys recommends using a 2% Sodium Hydroxide and 1% Sodium Metasilicate solution for removing support material from Polyjet parts. However, PADT's testing has shown no advantage to using this mixture in the SCA over using the WaterWorks solution. Therefore, PADT recommends using the WaterWorks concentrate to avoid having to store and mix your own chemicals.

# Support Cleaning Apparatus (SCA) Systems

## THE SCA-1200HT AND SCA 3600



The SCA-1200HT and SCA 3600 are specifically designed for the removal of soluble support materials on 3D printed parts. The units are compatible with all Stratasys soluble support materials and corresponding build materials in conjunction with all recommended support removal concentrates – ABS, ASA, PC, Nylon, and PolyJet Resins. The versatility and efficient cleaning performance of these devices result from PADT's experience as a user and distributor of the SCA and Stratasys FDM systems since their introduction.

Since the launch of the original SCA-1200 in 2008, PADT has successfully manufactured and supported the SCA family of cleaning systems for users worldwide.

Both units also includes a "no-heat" option for using the device with the heater turned off, perfect for PolyJet parts.

SCA Summary System Specification		
Item	SCA-1200HT	SCA 3600
Build Materials Supported	ABS, ASA, PC, Nylon, All PolyJet Resins	
Support Material Removed	SR-30, SR-35, SR-100, SR-110, SUP706	
Temperature Presets	No-Heat, 50, 60, 70, and 85°C	
Power	110VAC or 220VAC	230 VAC, 15A
Size	26 L x 17.5 W x 20.5" H 660 L x 445 W x 520 mm H	36.5 L x 22.8 W x 42.8" H 927 L x 578 W x 1,086mm H
Recommended Water Volume	12.2 gal / 46.3 L	27 gal / 102 L
Removable Part Basket Size	10 x 10 x 12" / 250 x 250 x 300mm	16 x 16 x 14" / 406 x 406 x 356mm
Construction	Stainless Steel Tub and Basket	
Alarms	Over Temperature, High Water Level Low Water Level	
Supported Cleaning Solutions	Stratasys WaterWorks TechniPrint Support Cleaner Concentrate	
Regulatory Approvals	CE, cTUVus	cTUVus/RoHS/WEEE
Key Operating Features	Whisper-quiet operation Easy access drain in front User programmable timer Spray nozzle optimized for flow Case design complements Stratasys system aesthetics Integral hinged lid Halt on alarms	
		Gentle setting for delicate parts Small Parts Basket

See below for recommendations on how to efficiently and effectively use the SCA-1200HT and SCA 3600.

# Safety Guidelines

## WORKING WITH CLEANING SOLUTIONS

When using WaterWorks, EcoWorks or other soluble concentrate with an SCA system, the following safety guidelines must be followed:

- Refer to the appropriate SCA User Manual on tank operation and safety. Understand how to properly and safely use the tank before operation.
- Do not allow aluminum or zinc to come into contact with the WaterWorks cleaning solution. WaterWorks contains sodium hydroxide.
- Always wear safety goggles (indirectly vented and chemical splash resistant).
- Use rubber gloves that can withstand the high solution temperature and high alkaline solutions. (Gloves that are cuffed at the elbow are recommended.)
- Follow your company and local regulatory statutes regarding safety practices.
- Never place hands in a tank filled with solution and/or hot water.
- Always use a proper tool to remove parts from the tank. Recommended are plastic or stainless steel removal tools that can withstand the high solution temperature and high alkaline solution in the tank.
- If using a basket, remove the entire basket from the tank before removing parts.
- Rinse parts after removal from tank before handling.

## OPERATING SCA SYSTEMS SAFELY

For your own protection and to ensure proper operation of the SCA please follow these safety precautions. Failure to use the SCA for the intended function may result in personal injury and will void the warranty.

- Do not operate the SCA until you have read and understood the user manual.
- Use the power supply voltage as noted in the Specifications section of the user manual.
- Always make sure that the power plug receptacle is easily accessible.
- Always place the unit on a flat, stable surface.
- If the unit has wheels, make sure those wheels are locked when not moving the unit.
- Avoid overloading the electrical outlet with multiple devices.

- Use only the power cord supplied by the manufacturer. Replace a damaged power cord with one approved by the manufacturer.
- Ensure the system is well-grounded. Plugging the SCA into a Ground Fault Interrupt (GFI) or similar protected outlet is recommended.
- Always power off and unplug the SCA from the power outlet when it is being cleaned, moved or serviced.
- Do not use the SCA for any purpose other than removing soluble support material from 3D printed parts.
- Always clean the unit with mild soap and a sponge or rag. Rinse tank completely before refilling.
- Wear thermal gloves and safety glasses when working near the SCA.
- Always stand upright with your head away from the tank when opening the lid to avoid vapors.
- Always remove some liquid from the tank before adding large parts in order to avoid overflow.
- Do not immerse the unit in liquid of any kind.
- Always operate the unit in a well-ventilated location.
- Always operate within environmental temperature range of 10 to 30 degree C.
- Before disassembling or attempting repairs on the system, contact Technical Support as directed in the Customer Support section of the user manual.

# Operating the Tanks

## CLEANING PARTS

Cleaning parts in an SCA system is easy and requires very little effort: make sure it is safe, set the temperature and time, add parts, walk away, then come back and remove the parts when they are done. Below is a basic outline with some advice to get the best performance. Please consult the user manual for detailed information.

1. VERIFY INSTALLATION, PLACEMENT, AND SAFETY

Inspect the unit and its placement. Make sure that it is safe to operate, is on a level surface in a well-ventilated location, and out of the way from being hit or bumped.

2. FILL OR TOP OFF THE TANK

If the tank is already filled with water and cleaning concentrate, then simply add water until the level is above the low water line, with the part basket in place.

If the tank is empty, add cool (not hot) water (about 11 gallons/41.6 L) for the SCA-1200HT and (29 gallons / 94.6 L for the SCA 3600). Add until the level mid-way between the high and low level marks, with the part basket in place.

3. ADD CONCENTRATE

If the tank was empty and recently filled with fresh water, then add concentrate as recommended by the supplier.

**Note:** Always add the soluble concentrate to the water, never add water to the concentrate. Use caution to ensure that you do not breathe in powder when mixing soluble concentrate with water.

Over time, evaporation can occur periodically so check for water evaporation. If evaporation occurs, add more water. Do not add more soluble concentrate.

Recommended Concentrate Amounts		
System	Cleaning Concentrate	Amount
SCA-1200HT	WaterWorks	1 Bottle
	TechniPrint	1 Quart
	EcoWorks	6 Packages
SCA 3600	WaterWorks	2 Bottles
	TechniPrint	2 Quarts
	EcoWorks	13 Packages

**Note:** Protective gloves and eyewear should always be worn when adding concentrate to the tank.

#### 4. TANK TEMPERATURES

To set the temperature for a cleaning cycle, press the proper preset temperature button for the base material type being cleaned, as shown in this table:

Recommended Temperature Settings		
Stratasys Material Name	Build Materials	Temperature
SR-30	ABS Based Polymers:	70° C
SR-35	ASA Based Polymers	70° C
SR-100	Polycarbonate Based Polymers:	85° C
SR-110	Nylon Based Polymers:	50°, 60°, or 70°C depending on wall thickness and acceptable distortion level
SUP706	All Stratasys PolyJet Resins	"Heat Off"
All	Rinsing Parts	"Heat Off"

## 5. REMOVE SUPPORT MATERIAL BY HAND

The amount of support material on a part directly affects length of material removal time and the amount of support removal concentrate consumed. It is recommended that as much support material as possible be broken off by hand before parts are placed in the cleaning tank.

Many operators have a trashcan next to their SCA and simply spend 30 to 60 seconds pulling off support material before placing the parts in the part basket.

Let the tank remove the remaining material.

## 6. LOADING PARTS

When the system reaches the requested temperature, parts can be loaded into the solution for cleaning. The best way to add parts to the SCA is to:

1. Press the Start/Pause button to pause the heater and pump.
2. If using a small parts basket, place the parts gently in the small basket and close its lid.
3. Raise the parts basket out of the system.
4. Gently place parts, or the small parts basket, into the main part basket.
5. Close the basket lid.
6. Slowly lower the basket into the tank.
7. Restart the system by pressing the power button.
8. Close the lid to the SCA.

This process avoids splashing and potential damage to the parts. Do not drop parts into the tank.

If the "high level" alarm sounds, press the mute button and remove liquid from the tank using a small bucket or cup.

**Note: Protective gloves and eyewear should always be worn when lifting the basket or parts from the tank.**

## 7. SET TIMER AND START CLEANING CYCLE

To set the timer, simply press the "Set" button then use the up and down arrows to set the number of minutes. Then press "Set" again and set the number of hours you want the system to run. Press "Set" a third time, then the "Start/Pause" button to begin the cleaning cycle.

Parts can be checked at any time by first opening the SCA lid, then the part basket lid and lifting the part basket from the system. Alternatively, a pair of tongs or a basket strainer can be used to remove individual parts for inspection.

**Note: Protective gloves and eyewear should always be worn when lifting the basket or parts from the tank.**

## 8. REMOVING PARTS

When the parts are done and are to be removed, make sure the timer has stopped the pump and heater. If the timer is still running, stop the pump and heater by pressing the "Start/Pause" button. Then lift the lid to the System and gently raise the part basket, resting it on the lugs inside the tank. Let the basket rest and drain for several minutes before opening the lid and removing the parts.

**Note: Protective gloves and eyewear should always be worn when lifting the basket or parts from the tank.**

Once the parts have drained, use a gloved hand or tongs to remove the parts from the basket. Rinse with water or place into an SCA with clean water for thorough rinsing.

Parts can be air dried or pat dried with a soft cloth or paper towels.

## MATERIAL SPECIFIC GUIDELINES

### POLYCARBONATE FDM MATERIALS

PC parts can absorb moisture if left in the tank for a long time and see a corresponding drop in material properties. A 5%-15% drop in stiffness is not unusual. For parts made with PC, check them frequently after about four hours and remove them from the solution as soon as the support material is removed.

## NYLON

The support material used for Nylon parts, SR-100, can expand in water. If support material is in a gap within the part, the expansion may cause distortion of, or damage to, the part. Therefore, it is recommended that users remove or crack some of the support material by hand within gaps on that part.

## NYLON 12 / NYLON 12 CF

Parts made of Nylon 12 and Nylon 12 CF are brittle when they are still hot from the build process. Always let them cool to room temperature before removing them from the build sheet and never place in a cleaning tank until they are at room temperature.

Hydration of Nylon 12-based parts actually makes them less brittle. Therefore all Nylon 12 parts should be left in an SCA for at least four hours to re-hydrate the material, even if the supports are removed in less time.

## BETWEEN CLEANING CYCLES

After removing parts from the tank, lower the baskets into the solution and close all lids. If the tank is to be dormant for two or more days, it is recommended that the power be turned off.

If the tank will be used again, it is recommended that 50°C preset be used to keep the tank at an elevated temperature. This will reduce the time and energy needed to re-heat the solution to a higher temperature.

Note: The SCA-1200HT and SCA 3600 are designed and tested for continuous operation at temperature.

If the SCA will not be used for an extended period of time, it is recommended that the tank be drained, cleaned as recommended below, and disconnected from power.

## MONITORING SOLUTION IN THE TANK

As support material is removed from parts being cleaned, the pH level of the cleaning solution drops. For WaterWorks concentrate, to guarantee efficient support removal, the pH level should be monitored and the cleaning solution should be changed out when the pH drops below a value of 11.5.

Typically an SCA-1200HT can process 2.4 lb. of support material and the SCA 3600 5 lb. of support material before the solution needs to be changed.

Some indications that it is time to change the solution are:

- The tank begins to cloud or exhibit low clarity. Some white parts (ABS) may turn brown or yellow.
- Parts have a sticky residue and/or stick together in the tank due to excess dissolved solids in the tank.
- Functional parts with moving features are not functioning properly.
- Support material is not fully removed after a long cleaning cycle.
- The tank's solution exhibits a low pH

Checking pH after each cleaning cycle is the best way to keep things efficient. To check pH level, it is recommended that standard consumer litmus paper pH test strips be used.

TechniPrint will change color when it's time to change the solution containing that concentrate.

## CHANGING TANK SOLUTION

When it is time to swap out the solution in the SCA, the liquid must be drained in a safe manner. First, allow the tank solution to cool to room temperature.

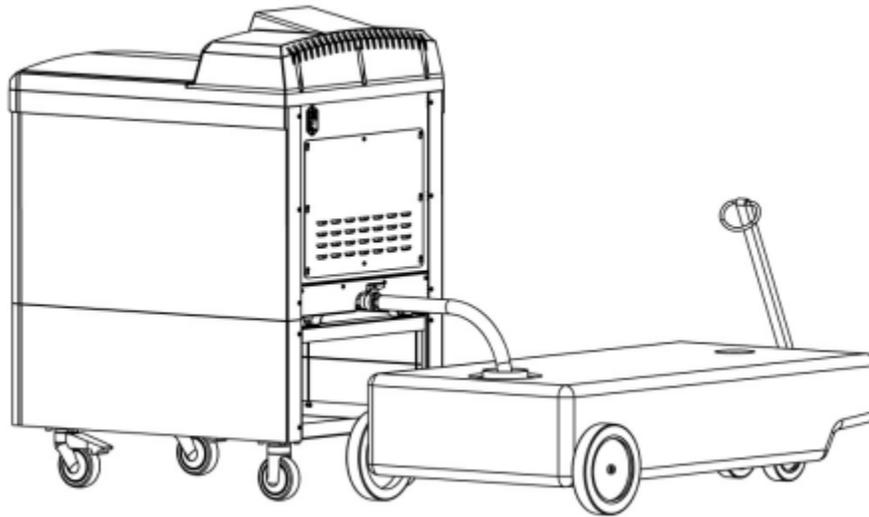
**Note: Protective gloves and eyewear should always be worn while draining the tank.**

Next, disconnect the power cord from the wall receptacle.

Ensure that the drain strainer is in place at the bottom of the tank.

To drain the tank, attach a hose to the drain valve located in the front of the SCA-1200HT and at the rear of the SCA3600. Place the other end of the hose in a sink, or in a plastic or stainless steel container which will be used to transport the liquid to a drain after dilution. Secure the end of the hose in the sink or container so that it cannot become loose during draining.

We have found that using a gray water tote, sold for use with recreational vehicles (RVs), is the fastest and easiest way to remove liquid from both sizes of tanks.



After the tank is completely drained, make sure the drain valve is in the closed position and remove and store the hose.

# Disposing of Support Removal Solution

A key thing to always remember is that the chemicals used to remove the support material are alkaline. They cannot be poured down the drain. Proper care must be taken for proper disposal or neutralization of unused concentrate or tank solution.

## DISPOSING OF CONCENTRATE

WaterWorks and TechniPrint concentrate (un-diluted material that has not been mixed with water in a SCA tank) must be treated as an industrial chemical and disposed of in accordance with local regulations. Please consult the Safety Data Sheet (SDS) and local requirements before disposing of any unused concentrate or empty containers.

## DISPOSING OF TANK SOLUTION

The used tank solution (the liquid in the tank that contains concentrate, dissolved support material, and water) is still alkaline, even though the pH is not high enough to effectively clean parts. As with the concentrate, the used tank solution must be diluted before it is disposed.

Used solution must be disposed of under applicable local waste disposal regulations. It is the responsibility of the user to determine and verify and follow the local disposal regulations.

Proper disposal requires that the alkalinity (pH) of the solution first be reduced to allowable levels. The pH may be lowered by either diluting the solution or by neutralizing it with an acid. Litmus paper or an alternative method of measuring pH levels should be used to determine if the pH level is within allowable levels for disposal.

If you used the WaterWorks Soluble Concentrate, it is recommended that you dilute the solution at a ratio of 5 parts clean water to 1 part used solution. More dilution may be required. Please check your local regulations.

If you are using EcoWorks cleaning agent, a dilution ratio of 1 part water to 1 part used solution is sufficient for most applications. More dilution may be required. Please check your local regulations.

If you are ever unsure as to which concentrate was used in your SCA, assume that the WaterWorks Soluble Concentrate was used and dilute accordingly.

There are many ways to efficiently dilute the solution. One reason a gray water tote is recommended is that water can easily be added, mixed with the drained solution, and then disposed of.

In some locations it is not acceptable to dispose of any type of alkaline liquid. For those situations, it is recommended that the used solution be stored in a drum and handed over to a waste removal company licensed to handle this type of material.

## TANK CLEANING

In normal operation, it is recommended that the tank be cleaned when the solution is changed. The intake and drain screens should be cleaned at the same time. See user manual for more information.

If you need to ship the tank for any reason, all concentrate residue should be removed prior to shipment.

To clean the tank, drain it completely and fill with clean tap water. Run the system for at least ten minutes to clear out concentrate. Drain the tank and wipe down all surfaces with a clean cloth or paper towels.

## Recommended Accessories

SCA systems ship complete and ready for use. However, a few accessories can assist with operation efficiency and safety. PADT has prepared the following list of recommended accessories that can easily be found with a quick internet search of the item name.

Recommended Accessories			
Item	Use	Notes	Image
Safety Gloves	Handling concentrate, solution, part tank, etc.	Must be long, waterproof, chemical resistant, and handle high temperatures.	
Splash Resistant Safety Goggles	Whenever working around systems with solution in the tank, splash resistant safety goggles must be worn.		
Tongs	Removing single parts for inspection.	The longer the better. Stainless steel.	
Strainer	Removing parts for inspection	A long handle and large basket are preferred. Stainless steel.	

<p>Covered, wheeled bucket</p>	<p>Filling Tank. Draining tank.</p>	<p>A lid helps prevent spilling.  An alternative is a standard bucket with lid and a mop bucket dolly.</p>	
<p>Gray Water Tote</p>	<p>Draining tanks</p>	<p>Sold with RV accessories.  Highly recommended. Much easier to work with than a bucket.</p>	
<p>pH Strips</p>	<p>Measuring pH</p>	<p>Strips are simple and cheap.  Try to find ones that are more accurate for high pH rather than full range (0-14)</p>	
<p>Cart</p>	<p>Storage and transport of SCA-1200HT</p>	<p>Great for moving desktop tank to sink or drain, or for storage when not in use.  Get a cart without a rim to avoid water in the tank's electronics.</p>	

## Where to Learn More

Do not hesitate to call PADT's support team at 1-800-293-PADT or 480-813-4884. They can also be reached via email at: [sca@padtinc.com](mailto:sca@padtinc.com)

PADT has a website: [www.padtinc.com/sca](http://www.padtinc.com/sca) for all things SCA and support removal.

We also publish content on our blog, [www.padtinc.com/blog](http://www.padtinc.com/blog)

The user manuals that come with SCA systems significantly more information. Information can be downloaded along with additional material in the download section of [www.padtinc.com/sca](http://www.padtinc.com/sca).

## Additional Information: Chemistry

The soluble material contains repeated groups in their molecular composition that like to bind with water, called hydrophilic groups. When those groups (-COOH, -O-, and -OH) connect to water molecules they leave the polymer chain they are in, breaking the chain and causing it to break up. Heat speeds the process of water bonding with those molecule groups. However, those same polymer chains that make up the material that is laid down by the printer contain molecules (-COO-) that push water away. Those groups are called hydrophobic ester groups.

The key to quick support removal is to neutralize the ester groups by making the water acidic (low pH) or alkaline (high pH). Although acidic chemicals work well at the start of the process, an equilibrium is reached and the process of removing the ester groups slows. Alkaline chemicals do not have this problem. They ionize the ester group and make it water-soluble. This removes them from the polymer, allowing water to also break up and dissolve the hydrophilic groups.

The build material used in both FDM and PolyJet systems does not have hydrophilic or ester groups, or has other molecular groups that bloc the reaction used in the soluble materials. The alkaline solution and gentle agitation in a support removal tank enable the chemical reactions to break up the polymers in the support material and leave the build material alone. The build material for FDM produced parts can also resist the elevated temperature, further speeding the process.

A more detailed and scientific overview of this process can be found on the PADT blog:

[http://www.padtinc.com/blog/additive-mfg/chemistry\\_soluble\\_support\\_removal\\_fdm\\_3d\\_printing](http://www.padtinc.com/blog/additive-mfg/chemistry_soluble_support_removal_fdm_3d_printing)