SAPPIRIM

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INFINITY SURFACES

Can they be kashered?

Infinity Surfaces is an Italian company that produces "porcelain slabs" which can be used as tabletops, counters, sinks, and more. One description is:

> What is porcelain slab? Porcelain is made from fine clay and a mineral called kaolinite. Feldspar, silica, and mineral oxides often come naturally in the clay, improving strength and color. This mix of clay and minerals is heated at incredibly high temperatures.[1]

This is borne out in the company's video[2] which notes that their surfaces are made from clays, sand, quartz, feldspars, and kaolins, and their website[3] which says:

> Infinity slabs are made of 100% natural raw materials and minerals. They are the same essential elements contained in granite, which, when sintered at a temperature of 1230°C, create a new, compact material with incomparable technical performance.

This description matches with what *Magen Avraham*[4] says is the defining criteria of *cheress* (ceramic), which cannot be *kashered*, as compared to *klei adamah* (earthen utensils) which can. *Klei Adamah* are utensils made of items mined from the ground, and, in that sense, *cheress* is similar. But what distinguishes *cheress* is that the earthen materials are fired in a kiln at very high temperatures in a manner that dramatically changes their physical properties. That is exactly what happens with these porcelain slabs. The finely ground clay, sand, etc. are heated to such temperatures that they begin to exhibit new characteristics that make them suitable to serve as counters etc. Since these porcelain slabs are classified as *cheress*, they cannot be *kashered* for *Pesach* or year-round.

In This Issue

AGRICULTURAL MITZVOS IN CHUTZ LA'ARETZ

ערלה, כלאים, בל תשחית

As a rule, agricultural *mitzvos* only apply in *Eretz Yisroel*. Thus, the *mitzvos* of שמיטה, תרומה, ומעשר do not apply in חוץ לארץ,[5] and it is generally accepted that the same is true of לקט, שכחה, ופאה.[6] However, there are some *mitzvos* which are land-based *mitzvos* which are relevant even in *chutz la'aretz*, albeit in somewhat limited fashion. This article will give an overview of three of those *mitzvos* – *arlah*, *kilayim*, and *bal tashchis*.[7]

ערלה

~ General rules

Fruits are forbidden as *arlah* if they grow during the first three years of a tree's life.[8] The prohibition includes all parts of the fruit, including the peels and pits, but not the leaves, sap, or other parts of the tree.[9] Not only may we not eat *arlah*, but it is even forbidden to have *hana'ah* (benefit) from it,[10] and it therefore, for example, cannot be fed to pets.

Fruits which grow in *chutz la'aretz* are also subject to the prohibition of *arlah*,[11] but there is a significant halachic difference depending on whether the fruit did or did not grow in *Eretz Yisroel* as relates to cases when one is unsure if a given fruit is *arlah* (*safek arlah*). If fruit grew in *Eretz Yisroel* and one is unsure if it is *arlah*, he must be *machmir* and not eat it, but if the same *safek* applied to fruit that grew in *chutz la'aretz*, the fruit is permitted.[12]

[1] https://eastcoastfl.com/2018/10/porcelain-slab-for-countertops/.
[2] https://www.youtube.com/watch?v=BqM2bdXHlyw.
[3] https://bit.ly/3v4Dnk8.
[4] *Magen Avraham* 451:4.
[5] *Rambam*, *Hil. Shemittah V'Yovel* (*shemittah*), and *Shulchan Aruch* YD 331:1 (*terumah* and *ma'aser*).
[6] *Shulchan Aruch* and *Rema* YD 332:1, as per *Shach* 332:1-2.
[7] Another land-based *mitzvah* that applies *mid'rabannan* in *chutz la'aretz* is *hafrashas challah* (*Shulchan Aruch* YD 322:3); details of that *mitzvah* are beyond the scope of this article.
[8] *Shulchan Aruch* YD 294:1.
[9] *Shulchan Aruch* 294:1-2.
[10] *Shulchan Aruch* 294:1.
[11] *Shulchan Aruch* 294:8.
[12] *Shulchan Aruch* 294:9-10.

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As a result of this *halacha*, most consumers in *chutz la'aretz* rarely consider the halachos of *arlah* since they may eat just about any fruit in the market, even if they do not know if it is or is not *arlah*. However, the halacha is quite relevant for people who have their own fruit-bearing trees, because they may know with certainty that a given fruit is from a tree which is less than three years old. However, even in that case, it is only forbidden to knowingly eat fruit from that tree. If the fruit was picked, and they are unsure whether it came from the "old" or "new" tree, they may eat it (in *chutz la'aretz*).[13]

~ Three years

As noted, *arlah* applies to fruits that grow during the first three years of the tree's existence, but that time period does not last exactly three years from the day of planting. Rather, the "three years" is calculated based on when in the (Jewish) calendar they were planted.[14]

- If the tree was planted between *Rosh Hashanah* and the 15th of *Av*, Year 1 ends on the next *Rosh Hashanah*, Year 2 ends on *Rosh Hashanah* of the following calendar year, and Year 3 ends on the 15th of *Shevat* of the year after that.

EXAMPLE

An apple tree was planted in *Nissan* 5782:

- Year 1 ends on *Rosh Hashanah* 5783
- Year 2 ends on *Rosh Hashanah* 5784
- Year 3 ends on *Shevat* 15, 5785

Total *arlah*-period: approximately 2 years and 10 months

- If the tree was planted between the 15th of *Av* and *Rosh Hashanah*, Year 1 ends at *Rosh Hashanah* of the next calendar year (i.e., more than 12 months after planting), Year 2 ends on *Rosh Hashanah* of the following calendar year, and Year 3 ends on *Rosh Hashanah* of the year after that.

EXAMPLE

An apple tree was planted in *Elul* 5782:

- Year 1 ends on *Rosh Hashanah* 5784
- Year 2 ends on *Rosh Hashanah* 5785
- Year 3 ends on *Rosh Hashanah* 5786

Total *arlah*-period: approximately 3 years and 1 month

The three-year *arlah* period will sometimes be restarted if the tree is transplanted, particularly if it is a "bare root" transplant (i.e., without dirt around the roots).[15] Similarly, if branches are cut off a tree and planted elsewhere, a new three-year *arlah* period starts for the sapling.[16] In contrast, if a branch is grafted onto a tree that is more than three years old (מרכיב), it "adopts" the post-*arlah* status of the host tree.[17] Another form of propagation is where the branch from a tree that is more than three

years old is "layered" into and out of the ground (מבריך) and begins to grow as if it is an independent tree. As long as the shoot (new tree) remains attached to the "parent" tree it maintains its post-*arlah* status, but as soon as that connection is severed the three-year *arlah* period must be counted once again.[20]

כלאים

In *Eretz Yisroel* there are many limitations on which vegetables and grains may be planted near one another,[21] but for those in *chutz la'aretz* there are very few restrictions.[22] One is that one may not plant the seeds of grapes together with two grains or two vegetables simultaneously.[23] The other is that one may not graft a branch from one "מין" to a tree from a different "מין".[24] The word "מין" is roughly translated as "species", but in truth there are many fine details involved in determining which trees are in the same מין and which are

כרם רבעי

Grapes that grow in the "fourth year" have the same status as *ma'aser sheini* and one must be פודה their *kedushah* before they are eaten.[18] [In *chutz la'aretz*, this halacha is limited to grapes and does not apply to other fruit].[19]

[13] *Shulchan Aruch* 294:9-10.
[14] The following is based on *Shulchan Aruch* 294:4-5.
[15] Based on *Shulchan Aruch* 294:16 & 19. See *Derech Emunah*, *Ma'aser Sheini* 10:88 for details of how much dirt must remain on the roots to not require a restarting of the three-year *arlah* period.
[16] *Shulchan Aruch* 294:16.
[17] *Shulchan Aruch* 294:16.
[18] *Shulchan Aruch* 294:6.
[19] *Rema* 294:7.
[20] *Shulchan Aruch* 294:16.
[21] See *Shulchan Aruch* YD 296 and 297.
[22] *Shulchan Aruch* 296:69.
[23] *Shulchan Aruch* 296:69. Even this is only *assur mid'rabannan* (in *chutz la'aretz*) (*Shulchan Aruch* 296:1). [There is no prohibition against planting seeds from other trees together with grains or vegetables (*Shulchan Aruch* 295:3)].
If the grapevine and two other grains or vegetables were planted at the same time, the grains or vegetables that grow there may not be eaten; but it is so uncommon that they were planted at the same time, that one may assume they were planted at different times (which is permitted), and the produce is permitted (*Rema* 296:69).
[24] *Shulchan Aruch* YD 295:1.

not.[25] Accordingly, *Rema*[26] cautions that הואיל ואין רוב העולם מכירין רוב המינין, טוב ליזהר בכולן.

If a tree was grafted in a manner that creates כלאים, fruit that grows on the tree is permitted.[27] *Shulchan Aruch*[28] says that it is forbidden to keep that tree, and all the *Poskim* accept that this is the simple understanding of the halacha. However, several *Acharonim* note that the common practice was that if a Jew purchased an orchard, he did not destroy or remove the grafted trees that were already in existence. Some justifications are given for this custom,[29] and if a person has such a tree, they should speak ask a Rabbi for direction.

בל תשחית

[The halachos of בל תשחית apply equally in *Eretz Yisroel* and *chutz la'aretz*]. The *Torah*[30] forbids us from cutting down fruit-bearing trees, and this is understood to mean that one may not wantonly destroying anything useful. However, if the tree no longer bears much fruit[31] or is damaging trees or property, then one may uproot it.[32] Furthermore, *Rosh*[33] is widely quoted as ruling that one may also cut down a tree if he needs the place where the tree is located, such as to build a home. Thus, in many cases when one would consider uprooting a tree, it is permitted to do so.

At the same time, the *Gemara*[34] speaks of physical danger that results from cutting down a fruit tree. Most *Poskim* appear to assume that this danger only applies when in cases where the halacha does not allow one to cut the tree down.[35] But due to the importance of avoiding danger (חמירא סכנתא מאיסורא) some caution that [even when uprooting is permitted], the actual labor should be performed by someone who is not Jewish.[36]

Another option is that instead of destroying the fruit tree, it should be transplanted to someplace else. In that case, the tree is not being destroyed, and – assuming there is a good chance the transplantation will be successful – there is no violation of בל תשחית.[37] [Some suggest that even in this case, the labor should be performed by someone who is not Jewish].

GLUCOSE

Simple sugar is not so simple after all

Sugars

Chemicals which have 6 carbons, 12 hydrogens, and 6 oxygens ($C_6H_{12}O_6$) are colloquially known as "sugars". The properties of each of these "sugars" depends on how the carbon, hydrogen, and oxygen are organized. While those details are not relevant to most *Mashgichim*, it is worth noting that there are four common "sugars": glucose, galactose, mannose, and fructose/dextrose. The physical structure of a fructose molecule is somewhat different than all the others, and, in turn, it is also sweeter than them. More on this below.

These four "sugars" are monosaccharides, which is to say that each molecule of glucose etc. is independent and not bound to any other one. An example of a monosaccharide found in nature is the fructose commonly found in fruits (hence the name, "fructose"). There are also disaccharides, which each contain two "sugars" bound together. The common ones which occur naturally are sucrose (table sugar), which is made of one glucose and one fructose; lactose (milk sugar), which is a glucose and a galactose; and maltose, which is two glucose molecules bound together.

The "ose" suffix indicates a sugar molecule

[25] See *Shulchan Aruch* 295:6 (and see also 297:14-15). For example, when discussing כלאי זרעים (which are not relevant in *chutz la'aretz*), *Shulchan Aruch* 197:15 writes:
יש זרעים ואילנות אחרים אע"פ שהם שני מינים בטבעם הואיל ועלין של זה דומין לעלין של זה או פרי של זה דומין לפרי של זה דמיון גדול עד שיראו כשני גוונים ממין אחד לא חששו להם לכלאים זה עם זה, כיצד הלפת עם הצנון אינם כלאים זה בזה מפני שפרייהן שוים, והלפת עם הנפוס אינם כלאים זה בזה מפני שהעלים שוים, אבל צנון עם הנפוס אע"פ שהעלים דומים זה לזה והפרי דומה לפרי הרי אלו כלאים הואיל וטעם פרי זה רחוק מטעם פרי זה ביותר, וכן כל כיוצא באלו.
The prohibition includes cases where a branch from a fruit tree is grafted onto another fruit tree or onto a tree that is not fruit-bearing (*Shulchan Aruch* 295:3), but not when two trees that are not fruit-bearing are grafted onto one another (*Rema* 295:6).

[26] *Rema* 295:6.

[27] *Shulchan Aruch* 295:7.

[28] *Shulchan Aruch* 295:7.

[29] See, for example, *Chasam Sofer* YD 288 (cited in *Pischei Teshuvah* 295:4) (the Jew can leave the grafted tree but not do anything to support it), *Aruch HaShulchan* 295:16-18 (prohibition of מקיים כלאים expires when the grafted areas grow together), and *Shevet Halevi* 7:185 (and 2:167) (cites many opinions and suggests that once the prohibition ends when the graft is no longer noticeable). In contrast, see *Chazon Ish*, *Kilayim* 2:9 & 11, who rejects these lenient positions.

[30] *Devarim* 20:19.

[31] What if the tree continues to bear fruit, but the farmer wants to plant trees that will bear more fruit? See *Minchas Shlomo* 2:100:2 that technically it is permitted, but one should only allow the uprooting to be done by someone who is not Jewish.

[32] See *Rambam*, *Hil. Melachim* 6:8-9 who says:
אין קוצצין אילני מאכל...ולא במצור בלבד אלא בכל מקום כל הקוצץ אילן מאכל דרך השחתה לוקה, אבל קוצצין אותו אם היה מזיק אילנות אחרים או מפני שמזיק בשדה אחרים או מפני שדמיו יקרים, לא אסרה תורה אלא דרך השחתה...וכן אילן מאכל שהזקין ואינו עושה אלא דבר מועט שאינו ראוי לטרוח בו מותר לקוץ אותו
It is also permitted to prune trees in ways that are beneficial for their growth (*Aruch HaShulchan* 116:13 and others).

[33] *Rosh*, *Bava Kama* 8:15, cited in *Taz* YD 116:6, *Chochmas Adam* 68:7, *Minchas Shlomo* ibid., and many others.

[34] *Gemara*, *Bava Kama* 91b.

[35] See *Darchei Teshuvah* 116:51, and the sources cited in the following footnote.

[36] See *Pischei Teshuvah* YD 116:6, *Minchas Shlomo* ibid. (citing *Tuv Ta'am Vada'as* 3:2:8), and *Aruch HaShulchan* 116:13.

[37] See *Chasam Sofer* YD 102.

Sugar molecules can bind together into long chains that contain dozens or hundreds of molecules. When there are more than 20 molecules bound together, they form something known as a complex carbohydrate or a polysaccharide. There are many forms of polysaccharides which are classified based on the type of sugar and the way the molecules bind (and branch). These include starch, cellulose,[38] pectin, agar, and gums,[39] which all play a role in food production. That said, starch is the only one which the human body can break-down (hydrolyze) into smaller sugar molecules and derive nutrition from. Another relevant feature of starch is that it is made of long chains of glucose molecules.

Generally, the longer the chain of sugars is, the blander its taste will be. Thus, monosaccharides and disaccharides are very sweet, and starches and other polysaccharides tend not to be.

Glucose Sources

Below we will see the multiple ways that glucose is used in industry, but – as a continuation of the previous section – we will note how it is sourced. The easiest way to obtain glucose (or other sugars) is from natural sources of monosaccharides or disaccharides. This includes fruit juice, sugar cane, sugar beets, and honey.[40] Additionally, lactose is a byproduct of cheese and whey (see the footnote).[41]

However, in most cases glucose will be taken from starches. Starch is plentiful and cheap, and, as we have seen, it is comprised of long chains of glucose. Amylase enzymes (i.e., alpha amylase, beta amylase) are used to break apart (hydrolyze) the starch's chains into progressively smaller pieces until one obtains the desires glucose molecules. A common example of this is corn syrup, which is the hydrolyzed version of corn flour/starch. Generally, the amylases which convert a bland-tasting starch into a sweet-tasting monosaccharide are classified as a *davar hama'amid*,[42] due to the dramatic affect they have on the starch's taste.[43] For example, if barley beta amylase is used to convert rice into rice milk, the rice milk cannot be consumed on *Pesach*, since it had a *ma'amid* that was *chametz*.

The "ase" suffix indicates an enzyme that affects sugars

As a rule, the status of the glucose – and everything made from it, as noted below – is directly connected to the source of the glucose. [Secondary concerns relate to the enzymes used (see above), and whether the equipment was used for non-kosher production]. In other words, apple juice, cane sugar, and sweet potatoes are inherently kosher, pareve, and kosher for *Pesach*, so glucose made from any of those sources would also be kosher, pareve, and suitable for *Pesach*. But if the "sugar" came from grape juice, lactose, wheat, or corn, the resulting glucose would be *stam yayin*, dairy, *chametz*, or *kitnios* respectively. [See below regarding *nishtaneh*].

Where, in fact, does the glucose come from? It turns out that the answer depends on which part of the world one is in, and on market conditions. At this point in time, the common sources in different regions are: United States – corn; South America – cane sugar; Far East – rice, sweet potato, corn; Europe – wheat and corn. These sources are based on the crops available in abundance in those locales and are not likely to change rapidly.

But market conditions also play a role. Specifically, it is usually not financially worthwhile to distill wine into ethanol (see below), since wine is more valuable. But there was a time when the French government propped-up wine prices by paying some manufacturers to distill their wine into pure ethanol, and at that time some ethanol on the market was non-kosher (*stam yayin*). Similarly, countries such as New Zealand and Ireland which produce considerable quantities of cheese, will sometimes convert the lactose byproduct into food-grade ethanol (see below).

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[38] For more on cellulose, see *Wood Products* in http://bit.ly/Sappirim22.

[39] For more on pectin, agar, and gums, see *Gums* in https://kshr.us/Sappirim29.

[40] Honey is primarily a mixture of the monosaccharides glucose and fructose but also contains a certain amount of sucrose (glucose and fructose bound together).

[41] Milk contains two proteins (casein and whey), fat, water, lactose, and some other minor components (e.g., calcium). Most cheeses are comprised of the casein and fat from the milk, leaving behind a greyish liquid which we call "whey", which in fact contains whey, water, and lactose. [There is a *machlokes* whether this "whey" is dairy *mid'oraisah* or *mid'rabannan* – see *Shulchan Aruch* YD 81:5 and 87:8]. This liquid can be further separated (using heat or filtration) to isolate the whey protein. After that is removed, the lactose that remains with the liquid can be recovered. [All agree that at this point the lactose is only dairy *mid'rabannan* – see *Shulchan Aruch* ibid]. For more on this see *Imrei Dovid*, *Animal Products*, Chapter 44.

[42] See *Imrei Dovid*, *Bitul and B'lios*, Chapter 1.

[43] In contrast, an enzyme used to sweeten corn syrup by converting some glucose into fructose (thereby creating high fructose corn syrup) is not considered a *ma'amid*, since that change is not significant enough. [Additionally, the glucose isomerase enzyme used for that process is an immobilized enzyme; for more on that see *Imrei Dovid*, *Bitul and B'lios*, Chapter 1].

Glucose Uses

Glucose plays an important role in human nutrition, in that the glucose which the body hydrolyzes from starch is what provides each and every one of us with the energy we need to function. It is also an important part of food production in the following ways:

~ Fermentations

Humans are not the only creature that derives nutrition from glucose, and in fact, glucose is the common energy source for most living beings. This includes microorganisms, which thrive when given a "diet" of glucose. We refer to this process as a "fermentation" which basically means that the microorganism is introduced to a vat of glucose (with other minor nutrients), where it reproduces and/or expels a desirable byproduct. Scientists have identified microorganisms which are either inherently valuable, or produce useful chemicals such as enzymes, vitamins, and flavorful chemicals. For example, fermentations play a role in the production of vitamin B12, monosodium glutamate, xanthan gum, citric acid, and many other food ingredients.

Some of those will appear on an ingredient panel, alerting the consumer that there is a kosher-sensitive ingredient in their food. But others, such as enzymes, are processing aids that do not have to be listed, and only someone familiar with food science will know to ask about. For example, the primary ingredient in cheese is milk, but if the rennet (enzyme) was propagated on *chametz* glucose, then the cheese is not kosher for *Pesach*.

~ Alcohol

A well-known natural fermentation occurs when yeast converts a "sugar" into ethanol to create beverage alcohol.[44] The simplest version of that is wine, in which yeast converts the sugar found in grape juice into alcohol, resulting in wine. The same can be done with other fruit juices to create "fruit wines" (e.g., plum wine), or with honey, to create mead. We have seen that starches can be hydrolyzed into glucose monosaccharides, at which point yeast can ferment the "sugar" into alcohol. This is how beer and sake are produced from barley and rice respectively. The grain is broken down into a wort of glucose molecules, and yeast converts the glucose into ethanol.

Byproducts

When yeast converts sugar into alcohol, it also produces carbon dioxide (CO_2) and some companies capture that gas and sell it for use in carbonated beverages. See *Sappirim* 9.

When the alcohol fermentation is completed, the spent yeast can be recaptured and sold as "brewer's yeast".

In some cases, the manufacturer will concentrate the alcohol within one of these beverages using a process called distillation.[45] Some concentrate the ethanol to a 20-60% concentration, to create Scotch (i.e., concentrated barley "wine"), brandy (concentrated wine), rum (concentrated sugar "wine"), or other whiskies. Others, continue to purify and concentrate the liquid until it is essentially pure ethanol, which is sold as "grain neutral spirits" (or just "ethanol").[46] Thus, one source of ethanol is from fruits or starch. As we have seen, the primary *kashrus* issue for these types of ethanol is the source of the "sugar". If the source is *chametz*, *stam yayin*, or dairy, the alcohol will retain that status.

But much of the ethanol used in the chemical manufacturing industry is sourced from petroleum. That ethanol is not produced by any type of fermentation and is instead a petrochemical product, which poses none of the potential *kashrus* issues noted above.

~ Vinegar

A secondary product of glucose is vinegar. This is because vinegar is produced when a microorganism, known as acetobacter, converts alcohol into acetic acid. Thus, if one adds acetobacter to wine [or if one leaves a bottle of wine uncovered so that acetobacter in the atmosphere can access the wine] the alcohol in the wine will "sour" into acetic acid, and the wine will become wine vinegar. The same can be done with "apple wine" (a.k.a. hard apple cider), "barley wine", or "rice wine" to create apple cider vinegar, malt vinegar, or rice vinegar respectively.

A related product is white distilled vinegar. This is produced by taking grain neutral spirits (defined above), diluting them in water, and then adding acetobacter (and minor nutrients). The acetobacter converts the ethanol into acetic acid to create a "pure" vinegar which is free of the color and taste associated with the grain it came from. As with alcohol, it is possible to create

[44] In chemical terminology an "alcohol" refers to a molecule with a hydroxyl group (an oxygen bound to a hydrogen) bound to a saturated carbon. The name of the alcohol depends on how many carbons the molecule has. For example, methanol has one carbon, ethanol has two carbons, propanol has three, etc. Thus, a chemist would refer to beverage alcohol as ethanol.

[45] Briefly: distillation involves heating the beverage to a temperature that is above the boiling point of ethanol (173° F) and below the boiling point of water (212° F) which causes the ethanol to boil out while leaving most of the water behind. The vaporized ethanol is captured and converted back into a liquid, which has a relatively high concentration of ethanol.

[46] In turn, vodka and gin are made from water mixed with grain-neutral spirits.

pure acetic acid from petroleum; this is referred to as "glacial acetic acid" and does not pose any *kashrus* concerns.

Thus, the *kashrus* sensitivity of vinegar – and the condiments made with it – is directly tied to the source of "sugar" used to create the alcohol from which the vinegar was made. In the case of vinegar, the *keilim* concerns are somewhat more pronounced than for alcohol. This is because alcohol producers tend to be reasonably limited to their starch/sugar sources. In other words, it is unlikely that the same company will be producing ethanol from both wheat and corn, or from wine and sweet potato. In contrast, almost every vinegar company produces wine vinegar (i.e., *stam yayin*) and white distilled vinegar, and there is often considerable sharing of equipment. Thus, even if the alcohol used in a particular vinegar is kosher, it is likely that the vinegar is tainted by contamination from non-kosher vinegar.

~ Ethyl Compounds

In addition to conversion into vinegar, ethanol is also widely used in the chemical industry as part of many compounds such as ethyl butyrate or ethyl formate.

A different use of ethanol is as a solvent which extracts a desired component from a plant product. In some cases, such as vanilla extract, the alcohol remains in the final product and is an obvious ingredient. But in other cases, such as CBD oil, the solvent is evaporated off once the extraction is complete. [That said, many extractions are performed with hexane, water, steam, or other innocuous chemicals].

~ Sugar Alcohols

Sugars can be "hydrogenated"[47] to create "sugar alcohols" that have much of the same sweetness as sugar and also have other desirable qualities. For example, sorbitol (hydrogenated glucose) does not promote tooth decay which makes it a perfect sweetener to add to toothpaste.[48] [Hydrogenated fructose is called mannitol, and hydrogenated maltose is called maltitol]. In fact, the ubiquitous presence of sorbitol in toothpaste [and the possibility it may be produced from wheat-based glucose] is the main reason cRc recommends it needs *hashgachah* for *Pesach*.

Sorbitol is the feedstock for ascorbic acid (Vitamin C), which is why that item is sensitive for *Pesach*. Additionally, when sorbitol is reacted with certain fatty acids it creates polysorbates. Year-round polysorbates are kosher-sensitive due to the presence of fatty acids, and for *Pesach* they are *chametz*-sensitive due to the sorbitol component.[49]

The "tol" suffix indicates a sugar alcohol

Nishtaneh

Above we noted the simple understanding that fermentations based on lactose or *kitnios*-based glucose are treated as dairy or *kitnios* respectively. It is, however, noteworthy that in cases where the fermentation product is dramatically different than the starting material, there are reputable American *hashgachos* who rule that the product is not dairy and may be consumed on *Pesach*. This is because (a) they consider a dramatic change – such as from sweet glucose into sour-tasting citric acid – to qualify as "*nishtaneh*", and (b) they rule that when dealing with an *issur d'rabannan* – such as the dairy status of lactose[50] or the prohibition of *kitnios* – one can be lenient regarding *nishtaneh*. Those who are lenient, limit that position to cases which meet both of these criteria. Other *hashgachos*, particularly those in *Eretz Yisroel* and most of the American *Heimishe* certifiers, do not accept this position.

A discussion of this topic is beyond the scope of this article.[51]

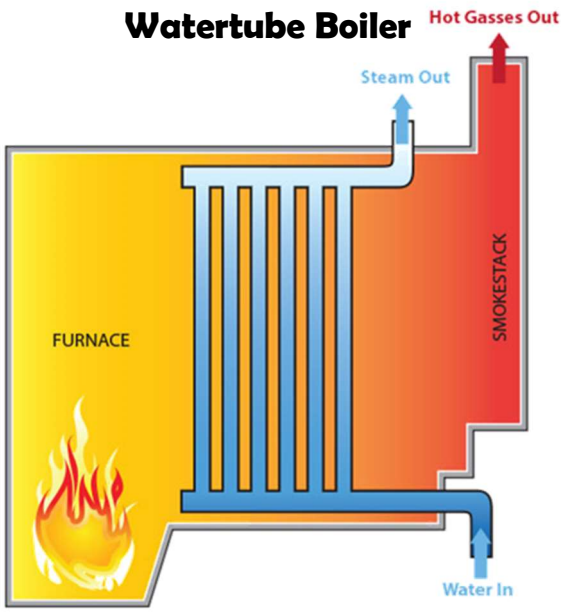
BOILERS

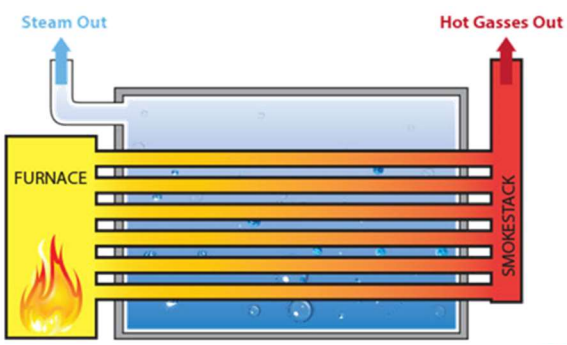
Flushing and pegimah sampling

Relevance

One of the most common methods of heating and cooking food in a factory is with steam or hot water, such as in a heat exchanger, jacketed kettle, or retort. In almost all cases, the process begins with steam created in a boiler which is in some remote area of the factory and which is rarely seen during a plant inspection. Basically, a boiler is a chamber in which a fire heats water until it becomes steam, and the steam passes through pipes all around the factory to different cooking

[47] Hydrogenation involves adding a hydroxyl radical (an oxygen and hydrogen) to the sugar molecule.
[48] A related item – which is not a sugar alcohol – is tagatose which is a "sugar" found naturally in certain foods but is commercially produced from tagatose found in lactose. Thus, this low-calorie sweetener [which also does not promote tooth decay] is dairy.
[49] See *Imrei Dovid*, *Bitul and B'lios*, Chapter 2, where it discusses whether polysorbates are treated as a *ma'amid*.
[50] See footnote 43.
[51] For more on the topic listen to the *shiur* at http://kshr.us/Nishtaneh.





Boiler diagrams from www.industrialboiler.com/

utensils. After the steam is used in processing, it condenses back into water, and that water is often returned to the boiler where it is re-boiled, and the process begins once again.

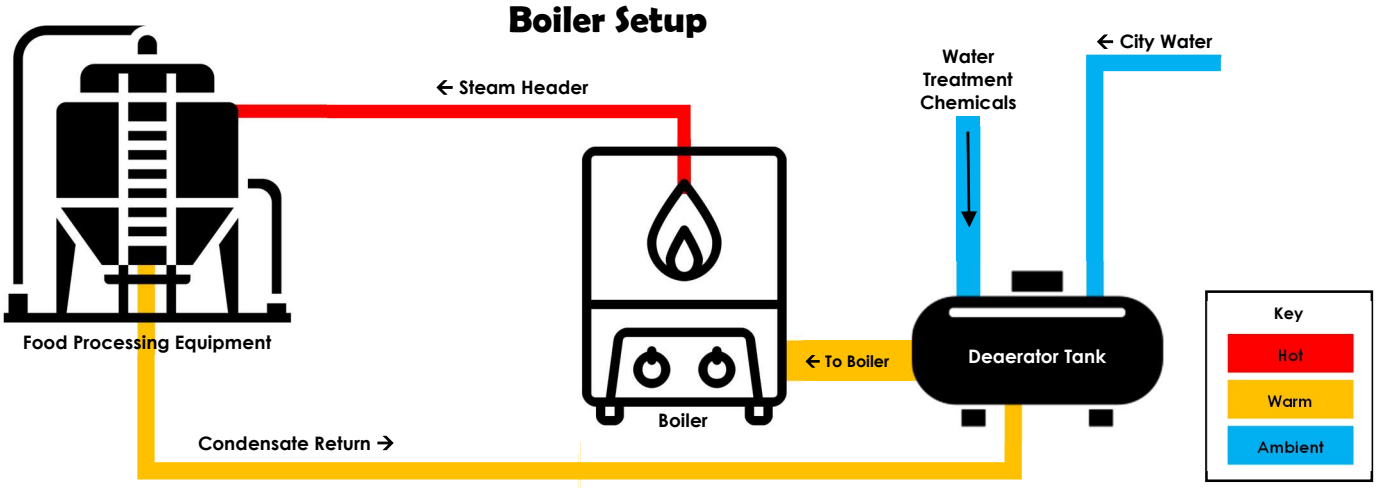
The boiler's presence becomes relevant to a *Mashgiach* in two instances: (1) *Bishul Yisroel* will be created by lighting or adjust the boiler, and/or (2) there is a concern that non-kosher or dairy *ta'am* from one part of the factory might spread to the kosher products via the boiler. This article will focus on the latter of those issues, and particularly on two details – flushing the boiler and *pegimah* sampling.

How long does it take to flush a boiler?

Flushing the Boiler

There are two basic ways to create a boiler: fire-tube and water-tube. In both, a large flame creates the heat that boils the water to create steam. The difference between them is whether the fire's heat is channeled through tubes that pass through a chamber filled with water (fire tube), or if the water is in tubes which surround or pass through a huge central flame (water tube). There are many practical differences between these types of boilers, but as relates to our discussion they differ in how they are flushed, as follows.

There are times when a factory's steam system becomes non-kosher, and all the water in that system must be purged. If the boiler is turned off



completely, then it is relatively easy to drain the boiler and refill it with fresh, kosher water. But in the case of a large boiler, suddenly draining out all the hot water will cause "thermal shock" and warp the tubes within the boiler. Accordingly, it takes many hours until the boiler cools sufficiently for the water to be drained out, after which fresh water would be added and the boiler restarted, and it will then take a few more hours until the boiler can produce steam (as above). Therefore, simply draining a large boiler is usually not a realistic option.

Instead, the non-kosher water will be slowly flushed out of the boiler (and steam system) during the course of regular operations. Essentially what happens is that the boiler remains in operation, but no condensate is allowed to return to the boiler. [This is accomplished by temporarily severing the connection between the condensate return tank (or the condensate return line) and deaerator tank]. The system compensates for this lack of condensate returning by drawing more city-water into the boiler. Thus, the incoming kosher city water essentially flushes the non-kosher condensate from the boiler and the steam system.

This type of flush is simplest – on both practical and halachic levels – in a watertube boiler. In a watertube boiler, water travels in one direction, from the water intake through a series of pipes until it leaves as steam. As fresh water enters the boiler, it pushes out the existing water until all the non-kosher water has been replaced. But in a firetube boiler, the water is basically all in one big pool. When fresh water enters the boiler, it joins that pool, and steam leaving the boiler comes from that pool. For example, when the pool is 75% old water and 25% new water, 25% of the steam leaving the boiler is "new water", which means that every 10 gallons of replacement water is only replacing 7.5 gallons of non-kosher water Thus, it takes considerably longer to flush all the non-kosher water from the firetube boiler than it would for a watertube boiler.

How long does it take to flush a firetube boiler to the point that the original/non-kosher water is *batel b'shishim*?[52] It depends on three factors:

1. Do we assume the original boiler water is 100% non-kosher, or do we follow the "10% rule" and, therefore, say the water is only 10% non-kosher?

   The "10% rule" is a position suggested by Rav Belsky that *b'lios* passing into a steam system are only 10% non-kosher. The logic and details of that position are beyond the scope of this article. Some accept this position and others do not.

2. How strong is the boiler? This is measured in "Boiler Horsepower" (BHP).

3. How much water does the boiler hold? We will want this answer in gallons. [Each gallon of water weighs 8.3 pounds].

   The boiler operator or others should be able to provide the answers to Questions #2 and #3.[53]

Using the information above, do the following: [A] multiple the BHP (#2 above) by 4,[54] and [B] divide that number by the boiler capacity (in gallons) (#3 above). This will give a "conversion percentage". [50-65% is common in industrial boilers]. Find the conversion percentage on the chart below, and you will have an approximation of how many hours it will take to flush the boiler **if it is used continuously**, and condensate is not returned.[55]

Note

In practice, the boiler **will not actively produce steam for 60 minutes of every hour** (that will depend on the factory's demands) **and, therefore, the time given will have to be extended**. For example, if the boiler only fires for 30 minutes of every hour, then it will take twice as long for the water to be flushed out.

[52] It is generally assumed that one does not have to be concerned with *ChaNaN* (and אפשר לסוחטו אסור) when dealing with condensate returned to a boiler.

[53] If plant personnel do not know how much water is in the boiler one can (over)estimate the amount as follows. [The following formula assumes the boiler is shaped like a long tube/drum laying on its side, as is common]. Measure the boiler's length (L) and diameter (D) in inches, and then enter them into the formula D * D * L * 0.0034. [This formula is a simplification of the actual formula which is $\pi r^2 * L / 231$ (there are 231 cubic inches in a gallon)]. For example, if a boiler is 120 inches long (i.e., 10 feet) and has a diameter of 60 inches, the formula would say that it cannot hold more than 1,468 gallons (60 * 60 * 120 * 0.0034 = 1,468). In truth, it surely holds less than 1,468 gallons since the boiler is not 100% filled with water and the walls and other parts of the boiler take up some space. But this formula shows the maximum amount of water that can possibly be in the boiler, which in our case leads to a *chumrah*.

[54] A BHP is equivalent to 33,479 BTU (per hour), and since it takes 970 BTU of latent heat to convert one pound of water into steam, each BHP can boil 34.51 pounds of water per hour. 34.51 pounds is equivalent to 4.14 gallons, and the text therefore rounds this to 4 gallons per BTU (לחומרא לא דק) which, in fact, is the ballpark figure used in the industry.

970 BTU is the latent heat required to boil 1 pound of water which is already 212° F. In our case, where the condensate is being drained, the water fed into the boiler is somewhat cooler since it is city water. On the other hand, the water is preheated in the deaerator tank. Accordingly, in creating the estimate noted in the text, we ignore this minor difference.

[55] The calculations given in the chart are based on information provided by Cleaver-Brooks (a boiler manufacturer), a mathematical formula based on Euler's Number created by Dr. Don Engelberg, Chairman of the Department of Physics at Queensboro Community College (when this author worked for OU Kosher), and detailed calculations done by hand/Excel to confirm the above.

Conversion Percentage	35%	40%	50%	60%	65%	75%
Hours to flush boiler water from firetube boiler…						
Assume 10% Rule	6	5	4	3.5	3	2.5
Water is 100% Non-Kosher	12	11	9	7	6.5	6

EXAMPLE

If a 40 BHP firetube boiler holds 259 gallons of water, its conversion percentage is 61.8% (40 * 4 / 259 = 0.6178). If we assume the water in the boiler is 100% non-kosher, we can estimate that the boiler must fire for 7 hours (without condensate returning) for the non-kosher water left in the boiler to be *batel b'shishim*. [It will actually take 6 hours and 40 minutes]. In practice, the boiler does not fire every minute, so we might require that condensate drain for two full shifts (i.e., 16 hours of production) to be sure it has flushed properly.

If the factory has more than one boiler (e.g., a primary boiler and a backup boiler), both must be drained of non-kosher condensate before kosher production begins.

Pegimah Sampling

~ Deaerator tank / draining condensate

Steam rises out of the boiler through the "header" (the primary steam pipe) and branches from there to the different processing equipment spread throughout the plant. After steam gives off its energy into the food, it condenses back into (hot) water. In most plants that hot water is pumped back to the boiler after making stops in a "condensate recovery tank" and/or a "deaerator tank" (a.k.a., DA tank).[56] In this way, the boiler is fed hot condensate instead of ambient temperature city water, and that saves them the cost of heating up that water. [It also saves them the cost of adding more boiler treatment chemicals, see below].

In some cases, a *hashgachah* will demand that the non-kosher condensate not be returned to the boiler. The *Mashgiach* should be aware that this demand conflicts with the company's desire to save money, so that plant personnel have a significant incentive to skirt that requirement. Accordingly, any commitment to not recover condensate should be verified by a qualified *Mashgiach* and reviewed on a regular basis.

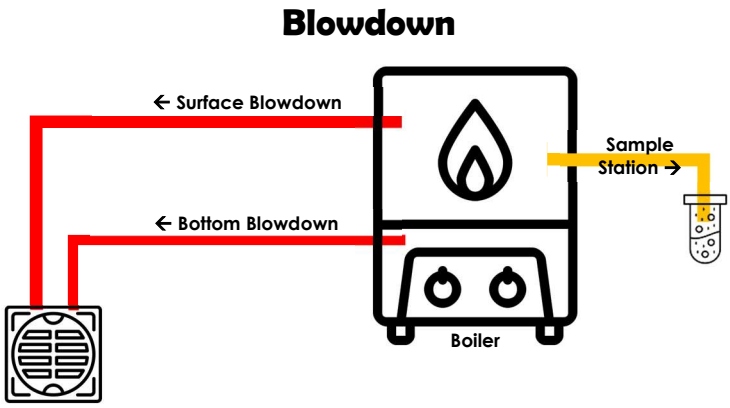
~ Chemicals / Pegimah sampling

In other cases, the *hashgachah* will allow the company to reuse condensate if a bitter-tasting chemical (*davar hapogem*) is added to the boiler. How is that done?

The components of a boiler (and a steam system) are somewhat delicate and sensitive, and therefore it is important that the water and steam in the boiler are as pure and controlled as possible. Towards that end, chemicals are added to the deaerator tank to control oxygen, pH, and other items which are collectively known as "dissolved solids". If a *davar hapogem* needs to be added to the boiler, it would be metered into the deaerator tank together with other boiler chemicals.

But boiler chemicals are expensive, and, therefore, companies use "blowdowns" to remove as much of the sludge or dissolved solids as they can. A blowdown is a mechanical means of drawing some water from the top (surface blowdown) or bottom (bottom blowdown) of the boiler and sending that water to the drain.[57] This removes the water which has the most contaminants, thereby minimizing the amount of chemicals needed. But this also means that the taste of this water is **not indicative** of the overall taste of the boiler water. Meaning, the blowdown water may have an offensive taste because it has so much sludge etc. in it, but that does not mean that the boiler water is *pagum*. Thus, **a *Mashgiach* should not taste this water as a test of the *pegimah* level of the boiler water**.

Rather, the *Mashgiach* should do what the factory does when it wants to determine the quality (e.g., total dissolved solids, pH) of the boiler water. They draw water from the center of the boiler where



[56] A deaerator tank is designed to remove oxygen/air (hence the name, deaerator) from water before it enters the boiler (as oxygen can ruin the boiler's tubes). In that tank, the water is also preheated with steam (so as to not "shock" the boiler with cold water) and pressurized, and that is where boiler treatment chemicals are added.

[57] The description in the text is accurate for a firetube boiler, and a similar method is used for a watertube boiler.

they have a "sampling station" for exactly this purpose. This is where the *Mashgiach* should take his sample from, when he wants to decide if the boiler water is sufficiently *pagum*. Another choice is to draw the sample from the deaerator tank.

Part of the decision whether to draw from the (center of the) boiler or the deaerator tank has to do with a halachic decision as to where the *pegimah* must be detectable, and a (related) choice of where boiler chemicals are added to the water. Those issues are beyond the scope of this article.

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