Hollow Coring

Hollow coring greens is a disruptive operation.

What size tine? How much top dressing? How long will it take?

The STRI offers some useful assistance in dealing with your hollow coring needs

Why model core aeration and top dressing?

It seems that thatchy greens are a perennial problem at a significant number of clubs. This may come as no surprise when often many greens are managed as if thatch were not a problem at all with limited hollow coring and/or scarification regimes employed.

While many greenkeepers have the desire to improve the situation, their respective committees often prevent them from carrying out the necessary work. Whether hollow coring (above) or deep scarifying, this reluctance is largely due to the fact that thatch removal is an invasive operation, and golfers generally fail to see beyond the short term disruption in play these operations cause.

When a thatch problem such as that seen above is identified, an array of questions arises. How do we rectify the problem? What will correction of the problem entail and how long will it take?

We know that hollow coring and/or (deep) scarification coupled with top dressing is the remedy.

Just how much top dressing is required and timescales for the work are more difficult questions to answer.

In this article the application of

THATCH LAYER: A deep layer of thatch immediately below the putting surface in need of removal to improve turf health and playing conditions. Several years of intensive hollow coring will be necessary to remove this thatch layer and return a uniform soil profile and firm surface.

mathematical models currently available are appraised. Three models that allow us to calculate appropriate tine sizes and amount of top dressing required are reviewed. It will become apparent that it may even be possible to set definitive targets and put a timescale on thatch removal programmes.

The models currently available

There are three models all of which are currently available online for use at their respective websites.

The first two models are of practical use as they stand, in that they are essentially simple calculators of area impacted through hollow coring, then the amount of top dressing required after coring.

Both models calculate using tine dimensions decided by the user. The third model, whilst perhaps being the most promising, is at present still in its developmental stage.

Look at

Greenfactory Productions Online tine tool:

http://www.greenfactory.co.uk/tools/tinetool/index.aspx

Online Wedge Hollow Tine Simulator:

http//www.wedge-bv.com/english/wedge_handelsmaatschappij.html

The 'Greenfactory Productions Online tine tool' and 'Online Wedge Hollow Tine Simulator' allow the user to calculate the area impacted by various coring operations. Area impacted when hollow coring has been documented by Baker (1983) and Hartwiger & O'Brien (2001).

These online models take the works of Baker (1983) and Hartwiger & O'Brien (2001) a step further, enabling the user to quickly calculate surface area impacted by various tine diameter, spacing and penetration depths.

Based on a predetermined target surface area, both calculators will also output the number of operations required to satisfy that target.

In the example shown below (Figure 1) the Online Wedge Hollow Tine Simulator model has been asked to calculate the area impacted using standard ½ in. (12 mm) diameter tines, arranged at 2 in. (50 mm) centres and penetrating to a depth of 3 in. (75 mm).

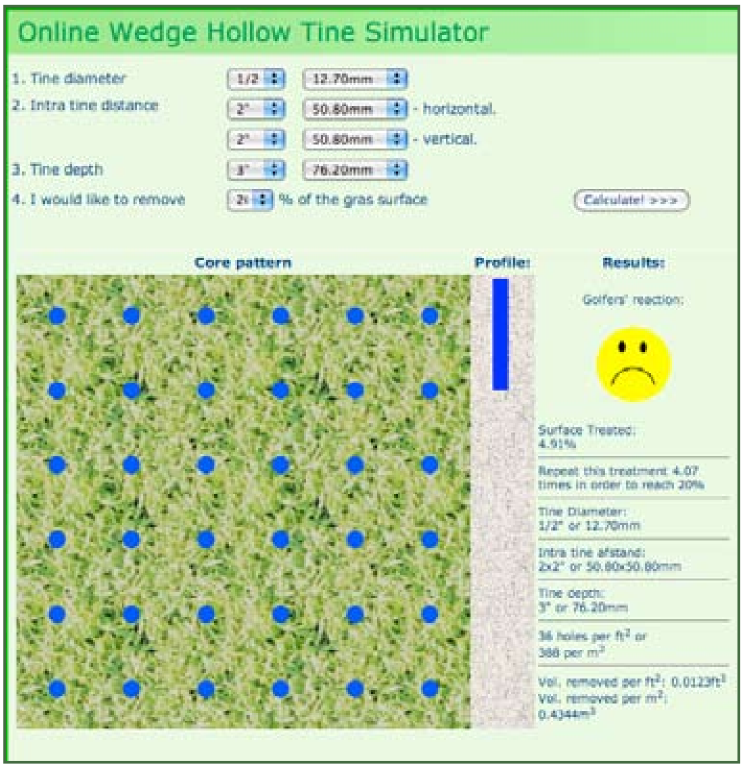


Figure 1: Input and output gained from the Online Wedge Hollow Tine Simulator. Modified from http://www.wedge-bv.com/english/wedge_handelsmaatschappij.html

The area to be worked (i.e. 5625 ft2 □ 500 m2) has been selected as that of a single green. A target area of 20% (annually) has been input.

This target is based on what a USGA Green Section report requires for a core aeration programme to be successful on mature greens (Hartwiger & O'Brien 2001). Hartwiger & O'Brien (2001) acknowledge that this figure of 20% impacted area is based on experience and not experimental data.

In certain circumstances, where thatch levels are very high for example, a greater surface area may need to be impacted to achieve the desired effect. The impacted area is thus dependent on your circumstances and adjusted accordingly.

After calculation, the output tells us that with the tine specification detailed, 4.91% of surface area will be impacted by a single operation (Figure 1).

Perhaps more importantly is the fact that more than 4 coring operations will be necessary to achieve the target of 20%. Indeed, the model is a little over simplistic in this regard as it makes no account for overlap of core tines in subsequent operations.

The Greenfactory Productions website can also be used to calculate the area impacted when scarifying as opposed to hollow coring.

For this, visit the website http://www.greenfactory.co.uk/tools/TineTool/scari.aspx

Online Top Dressing Calculator:

http://aggie-turf.tamu.edu/aggieturf2/calculators/topdress-sheet.html

More often than not, having opened up the soil profile through coring, one wants to replace the removed material with fresh top dressing to dilute thatch, restore surface levels and firmness, improve drainage and/or generally improve the overall quality of the rootzone.

This model enables the amount of top dressing required after a specific coring operation to be calculated.

As with the tine simulator above, this model requires the input of the tine diameter, depth and spacing, the latter needing to be input as the number of cores per unit area (i.e. cores ft-2), which are documented by Hartwiger & O'Brien (2001).

In addition, the total area to be top-dressed and depth of top dressing required on the surface are also required as additional parameters for the model to calculate.

Usefully there are three outputs from this calculator: (i) the amount of top dressing required if the surface were not hollow cored, (ii) the amount of top dressing needed to fill the specified hollow core holes and (iii) the amount of top dressing required to fill the hollow core holes and satisfy the amount of top dressing required on the surface.

One criticism of the model might be that it appears to assume that all the top dressing applied will fully integrate into the tine holes. In practice, of course, the integration of sandy dressing is often problematic.

Following on, the previous calculation made in hollow tine simulation is followed through. The amount of top dressing required is calculated for ½ in. diameter tines arranged at 2 in. centres and to a depth of 3 in.

From these parameters the model has calculated that 9 ft3, 69 ft3 and 78 ft3 is needed to apply 0.02 in. (0.5 mm) of top dressing to the un-cored surface, to fill the holes, and to fill the holes and provide 0.02 in. of top dressing respectively.

Assuming that the bulk density of sand is typically 1.75 tonnes m-3 (Baker 1990), these amounts equate to approximately 1.0 kg m 3, 6.0 kg m-3 and 7.0 kg m-3.

Core Aerification And Top-dressing Model:

http://www.ag.ndsu.nodak.edu/plantsci/turf/main.htm

This Core Aerification and Topdressing model is a computer simulation that evaluates the effectiveness of hollow coring and top dressing (Li et al. 2002).

It is valuable in that you can model several scenarios and set certain targets you wish to attain. Examples of possible scenarios that might be modelled are a soil exchange programme, removal of thatch or an imported sod base after turfing.

The model can also be run for soil and sand based greens. A selection of coring and top dressing programmes can be selected.

These regimes include hollow coring, removing cores and top dressing; hollow coring breaking down cores and top dressing; hollow coring with no top dressing and top dressing alone.

Modelled calculations require more detailed input parameters.

As well as the hollow tine dimensions (i.e. diameter, depth of penetration and spacing), the model also requires bulk density of indigenous soil, the amount of top dressing sand in indigenous soil as well as a target for the amount of sand within a predetermined depth of soil.

If the model were to be used out in the field, then the existing soil and top dressing material would need analysing for bulk density and sand content in order to devise a suitable coring and top dressing programme.

In the example a scenario has been set up where the aim is to carry out a soil exchange programme. The objective is to improve the sand content of a soil based rootzone to 4 in. (100 mm).

Bulk densities have been assumed to be that of a typical clay soil (Brady 1990) and sand (Baker 1990). The existing soil is said to contain 20% (w/w) sand and a target of 80% (w/w) sand is set. Tine dimensions have been set as standard ½ in. (12 mm) diameter arranged at 2 in. (50 mm) centres and penetrating to a depth of 3 in. (75 mm).

With these parameters input, the model calculates that a green of 25 by 25 yards (i.e. 5625 ft2 □ 500 m2) will need to be cored 18 times and require 3 yd3 of top dressing after each coring treatment. In addition, by the end of the programme 88% of the surface area will have impacted.

Again assuming a typical bulk density of top dressing sand is 1.75 tonnes m-3, the volume of sand needed after each coring treatment can be estimated in kg m-2.

The model's estimate of 3 yd3 equates to approximately 8 kg m-2. This figure initially appears high, but the model calculates that a minimum of 0.02 in. (0.5 mm) layer of sand is laid down across the whole surface as well as filling the holes.

However, returning to the Online Top Dressing calculator, it was calculated that 6 kg m-2 was needed to fill the holes alone, this figure being more in line with standard recommendation. Data for deep scarification would also be a useful additional parameter for the model.

While having great potential for devising suitable hollow coring programmes, this model cannot as yet be used out in the field due to the lack of empirical data.

Field experimentation is necessary to fully validate the model and ensure the coring programmes it devises are sensible.

Sensitivity analyses are also required to identify the most important parameters affecting the model.

The model appears to be sensible for the inputs it is generating. For example, it correctly decreases the number of hollow coring operations required with increasing tine size and/or a decrease in tine spacing arrangement.

However, there is lack of flexibility in that at present it assumes that there is no overlap between coring operations.

Also a programme encompassing the use of different sized tines at different times of the year cannot be determined at present.

It should also be noted that this model can only be used to estimate the removal of existing material, no account is made for increasing organic matter as a consequence of ongoing growth.

Removal of sod base could also be contentious as no account is made for depth of sand applied and building on top of a sod layer.

Conclusion

The Online Wedge Hollow Tine Simulator and the Online Top-dressing Calculator may appear a little simple, but what they do achieve is offer the ability to make more informed decisions when formulating hollow coring regimes.

By calculating the area of turf affected by certain coring operations, it becomes apparent how little material we might be removing on an annual basis.

This may, in certain circumstances, explain why thatch problems remain. It is often the case that despite top dressing after coring, the holes remain visible and render the surface uneven.

Visibility of the holes may be influenced by accelerated growth of turf over the holes as well as the holes not being completely filled with top dressing.

The top dressing calculator indicates that we might be under-applying top dressing after coring, thus compromising aesthetics and smoothness of playing surfaces.

While these models go some way to answering the questions of how we rectify a soil profile problem, what that will entail and how long it will take, the model with the greatest potential is the Core Aerification and Topdressing Model

This model enables the user to run several scenarios before deciding upon the most suitable coring and top dressing programme.

Timescales for different hollow tine set-ups can be evaluated against predetermined targets derived from soil analyses and a suitable hollow coring and top dressing programme decided upon.

The failing of this model at present is a lack of empirical field data needed to evaluate how sensible its outputs are.

Compost... The environmentally friendly way forward

Having forged a reputation as one of the most challenging venues to have ever hosted The Open, Carnoustie is now establishing a strong set of environmental credentials as well. Paul Mathers, of WRAP, discusses how quality compost is being used to maintain its three prestigious links courses...

Recently Carnoustie, which hosted two of the most exciting Open Championships of the last dozen years in 1999 and 2007, has been turning its attention towards its environmental standing, ensuring that the 46,000 golfers who play the course each year do so in the knowledge that they are playing on one of the greenest golf courses in the world.

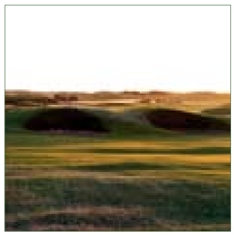
As part of this ongoing commitment, the Club has produced an Integrated Environmental Action Plan which sets out how it addresses the careful management of turf grass and non-playing area habitats. This covers a wide range of environmental activities such as water management, waste reduction and energy efficiency in a bid to improve Club-wide environmental performance.

One particular aspect of this commitment is the Club's decision to trial the use of high quality compost in the repair and maintenance of all three links courses. Compost manufactured to the BSI PAS 100 specification, which ensures quality and consistency to the highest standard, was first used by greenkeeping staff to improve the growing conditions of ground under repair, and subsequently as a constituent element of divot mixes.

The first of these trials was in 2007 when Carnoustie's greenkeeping staff needed to re-model and re-seed an area of rough and semi-rough adjacent to the 18th green, just short of the Barry Burn. Crucially, because the Club closes for no longer than two weeks each year, this urgent work needed to be completed as quickly as possible so the area could be back into play. It was critical also that natural flora was protected, and that native grasses were encouraged to re-establish.

Course Superintendent, John Philp, worked in close consultation with the sports, amenity and landscape supplier Rigby Taylor and applied organic matter to the areas in the form of BSI PAS 100 compost. Around seven tonnes of quality compost was locally sourced from Forth Resource Management in Edinburgh, and applied to the area to improve soil consistency and encourage rapid re-establishment of grass.

The results were remarkable. Because the soil in the Carnoustie area tends to be sandy, all water



and nutrients quickly drain away making support for vegetation limited at best. But though the use of that quality compost, nutrient and water content improved and enabled vegetation to re-establish swiftly and healthily. Importantly, the ground under repair was also brought back into play in half the normal amount of time allowed for such work.

Based on the success of this trial, the Carnoustie team were keen to examine other application opportunities. With its ready and plentiful supply of nitrogen and phosphorus and other nutrients and minerals, BSI PAS 100 compost was found to be an ideal material for divot replacement.

A further 30 tonnes of BSI PAS 100 certified compost – prepared to a 6mm grade – was sourced and mixed at a ratio of 3 to 1 (sand to compost) to produce the basis of a divot mixture. Grass seed was added, alongside a seaweed meal to provide additional micro nutrients and mirror the make-up of the natural seaside links soil. The divot mixture has been a great success as well. Grass flourishes and colouration of the turf matches the rest of the course seamlessly, giving a highly professional finish. John Philp and his team are now looking at how BSI PAS 100 compost can be used in a topdressing mix for use in weaker, more drought susceptible areas.

Crucially, the trials at Carnoustie also resulted in significant cost savings. Compared to fensoil, for example, the use of BSI PAS 100 compost resulted in a saving approaching 30% - or around £13 per tonne. Encouraging, this saving came in part from the significant reduction in transport costs; while fensoil is sourced at the other end of the country in the south east of England, BSI PAS 100 compost can be sourced locally from Edinburgh and all around the UK.

The example of Carnoustie demonstrates that world class results can be achieved more economically, and more environmentally friendly, than by traditional methods. And for greenkeepers keen to replicate Carnoustie's success, WRAP provides a comprehensive Compost Suppliers Directory that enables greenkeeping teams to search by postcode for their nearest BSI PAS 100 compost. This means that every golf course in the UK now has the opportunity to emulate Carnoustie's move to a greener links.

about the author

Paul Mathers is Waste & Resources Action Programme Manager for Landscape & Regeneration.

For more information on how Carnoustie Golf Club has been using BSI PAS 100 compost, visit www.wrap.org.uk/sportsturf or call Paul Mathers at WRAP on 01295 817899.

wrap

Red Alert

Confusion surrounds the conditions of use for operators fuelling vehicles and turf machinery with red diesel. Ed Philips seeks to clear the undergrowth

`Red` diesel has long been employed in the landscaping, local authority, horticulture and farming sectors as a far cheaper alternative to its `white` counterpart.

Yet vehicles and machinery operators remain confused about the conditions for its use. What is crystal clear however is that penalties, even vehicle seizures, can result from illegally deploying the fluid in tractors, utility vehicles and turf machinery, for example.

Publication of a new order in 2006 amending the list of vehicles allowed to use rebated fuel (red diesel) has only served to muddy the waters further it seems, notably over its definition of tractors qualifying as exempt vehicles.

In a bid to clarify confusion for end users, H M Revenue and Customs – the government agency charged with policing red diesel – and the DVLA jointly issued a Memorandum of Agreement on 10 January 2008, which defines permitted and prohibited use of the fuel in "agriculture, horticulture and forestry".

To add clarity, GI answers questions about the dos and don`ts of the fuel.

What is red diesel?

It's a rebated fuel, which, compared to regular 'white' diesel, has a far lower tax charged on it. The fuel is dyed red to discourage general use and to allow the authorities to spot suspected illegal use.

An invisible chemical tracer is added so that even if the dye was removed, tests on a fuel sample would reveal it to be non-road legal.

Legislation was first introduced in 1935 to allow vehicle concessions for red diesel but the passing of the Hydrocarbons Oil Duties Act 1979, Schedule 1, updated the law to include tractors.

Who can and cannot use it?

The memorandum of agreement states that red diesel is allowed to be used in "farming the land, agriculture, horticulture and forestry" but is barred from use in the "breeding, rearing or keeping of any creature relating to sport or recreation, dealing in agricultural, horticultural or forestry products, landscaping, or the maintenance of recreational facilities".

If a vehicle requires a tax disc, it also requires white, not red, diesel.

When, where and in which vehicles can red diesel be deployed?

Three categories of legal operation apply to the amenity sector – "unlicensed vehicles, mowing machines and tractors". An unlicensed vehicle is one not used on public roads and untaxed.

However, if a vehicle has become untaxed since 31 January 1998, it will require a Statutory Off-Road Notification (SORN).

Mowers – whether pedestrian or ride-on – must be a "complete vehicle" to use the fuel. The "machinery" (engine) must be built into the vehicle for it to qualify under this category.

A tractor with mowing equipment attached to it for example would not qualify in the mowing category as it is not purpose-built – an exclusion also applying to any type of utility vehicle with removable mowing machinery attached to it.

Conversely, a vehicle consisting of a Land Rover chassis for example, with permanently fixed grass-cutters, designed and constructed for grass-cutting and used solely for that purpose.

Tractors, however, offer the most scope for misinterpretation. To qualify as an exempted/excepted vehicle, the tractor must be "agricultural" - designed and built for use other than on roads.

To be driven on public roads legally with red diesel in the tank, tractors must be used solely for one of three applications – "purposes relating to agriculture, horticulture or forestry, for cutting verges bordering public roads, or for cutting hedges or trees bordering public roads or bordering verges which border public roads".

What machinery cannot be fuelled with red diesel?

The chief confusion surrounding the law on red diesel centres on the definition of what the memorandum means by "agriculture, horticulture and forestry".

HMRC's view remained clear that the definition did not include (and never had) landscaping and maintenance of recreational facilities.

The public sector and amenity organisations may have naively deployed red diesel and been forced to make costly changes later. Agricultural contractors for example, could be faced with similar setbacks if they've driven tractors while undertaking amenity contracting alongside their mainstream business.

The view now is that if a tractor is utilised for amenity work it cannot also do agricultural work – unless it is retaxed and the fuel drained down and changed, which in most cases is impracticable.

To avoid paying the penalty, the only safe advice is to fuel tractors on white diesel if they are not used 100% on agricultural, horticultural or forestry duties.

What are the penalties for illegal use?

It is a criminal offence to misuse or supply red diesel or mix it with any other fuel, as it is to move any designated chemical marker or dye from the red diesel or add anything that might counteract the marker.

Offenders can be penalised by being charged for the backlogged fuel and even by having vehicles seized.

In some cases, offences may be dealt with in the criminal courts where a prison sentence of up to seven years could be imposed.

They may also be asked for backdated fuel payments, although some leniency appears to be shown in the amenity sector to allow for pre-memorandum confusion surrounding the use of red diesel.

The threat of punishment is real, however and one council has been asked for payments backdated to Jan '08.

The council had their parks department tractors dipped for red diesel useage by HMRC, believing that their grounds maintenance operations were thought to be exempt from full excise duty.

The assessment resulted in a notice to pay more than £20,000 in excess duty, covering the period from January 2008.

Powder Coating: *Who Me?*

Sean Sullivan, Superintendent at Briarwood Country Club in Montana, USA, offers some practical advice on powder coating which can add years to some of your course furniture and make significant savings

Has the appearance of the ball washers on your course deteriorated to the point where aerosol paints are not helping anymore? How about your cups?

If you don't have the budget to replace these accessories, there is a way to bring back the "factory look." Like the factory, you can powder coat your course accessories. Here at Briarwood, we have powder coated our ball washers, ball washer brackets, cups, and sprinkler head tags.

Powder coating can be done in your shop with very little start up money. To start, you need a powder coat gun. A basic gun can be purchased from Electro Static Majic. The powder coat gun kit costs £119. Next, you will need an oven that is capable of baking at 180 C. Usually any oven is capable of this temperature, regardless of condition. Remember, the oven doesn't have to look pretty because all you need is the baking ability. I acquired our oven by asking the membership, in the monthly newsletter, if anyone was throwing one out or had one in storage somewhere. It took less than a week to get it. Most importantly, don't use your wife's oven as I will not be responsible for the trouble that causes.

We have a sandblaster to remove the old finishes off the equipment, but a sandblaster is not a necessity as long as you remove the old finish down to the metal. Once the old finish is removed, wipe down the metal with mineral spirits. That will remove any surface contamination such as oil, dirt, or dust. Also, use latex gloves when handling the metal to keep the oils on your fingers and hands from contaminating the metal surface. If you want to get a sandblaster, Northern Tool UK has a couple of DIY models that range in price from £185 to £250. Be sure to check the specification of the sandblaster to make sure you have an adequately sized air compressor.

Now you are ready for the powder coating process. Powder coating works by statically charging both the metal object being coated and the powder itself. When dusted, the powder sticks uniformly to the surface of the object. Once coated the object is placed in the preheated oven for 15-20 minutes. After the timer goes off, remove the item from the oven and let cool. Once cooled to the touch, that object is ready to be put into service. That's part of the benefits to powder coating, there is no drying time needed to cure the paint.

When we powder coated the ball washers, we fabricated t-bolts for the tops allowing us to coat the bottom edges. We screwed the t-bolts into the ball washer tops and placed on a cookie sheet. We attached the electrical lead to the cookie sheet. A scrap piece of steel plate will work if your wife won't let you have an old baking tray. Remember to let her know that she won't be getting it back! The baking tray or steel plate is just an easy way of transferring the work to the oven. Apply a uniform coating of powder to the ball washer top and then bake for 15 minutes. Using the cookie sheet we were able to bake two tops at a time. For the body of the ball washer we fabricated a stand that resembles and functions like an engine stand. It allows us to rotate the ball washer so we can put on a uniform coat. The stand also supports the ball washer during the baking process; our oven isn't big enough to stand the ball washer on its end.

We built two stands so that we could be baking one ball washer and be coating another at the same time, to speed up production. We built the stands with scrap metal that we had lying around the shop. Although during the winter, production speed isn't a priority. It is always good to know your limits. Here in the States, if you send out the ball washers to be recoated it will cost about $60 for each ball washer, in the UK that is the equivalent to £38.

If you use aerosol paint the finish is gone by mid season. Note: the powder comes in a large variety of colours and textures so you can customize your ball washers any way you want. We coated 32 ball washers with an equivalent cost of £35 of powder. Even if you add in the cost of the gun, it is still cheaper than having five ball washers done by an outside business. Another benefit to doing your own powder coating is that you can put on a thicker coat than the factory. Remember that the factory is in it for the profit and what we need is durability. Once the parts are coated and cooled, the ball washer can be re-assembled and put back into service.

To coat the cups, thoroughly remove all sand and dirt from the cups. Sand grind, or chemically remove what's left of the old finish. You can purchase ¼ kg of gloss white powder for7.99 pounds sterling. I suggest that you buy extra powder to have on hand for when you need to freshen up the cups. The ¼ kg will be enough to restore two sets of cups. The powder coated finish will last longer than aerosol painting and is quicker to do. It takes about 10 minutes to cleanup and remove the old finish. The act of powder coating takes about two minutes, at most. Comparing that to two or three coat of aerosol paint, if applied

correctly, will take 5-10 minutes. Bake the cups for 15 minutes and when the cups are cool to the touch, are ready to be placed into service. Painting will take several hours to harden, depending on temperature and humidity.

Total time for the powder coating is 30 minutes for individual pieces and each piece has a better finish than with aerosol painting. I don't have the replacement cost for cups in the UK, but I can guess that it is more than £7.99 for two complete sets of cups.

We fabricated our own ball washer brackets to support the ball washers on wooden posts. I purchased 1 kg of gloss black powder which was enough to cover 39 brackets, with some powder left over.

We fabricated a support stand to hold four brackets for the powder coating and baking process. After fabricating the brackets we removed all the sharp edges with a grinder.

Then we thoroughly cleaned the metal with mineral spirits. We placed four brackets on the homemade stand and began to powder coat. Remember to check all the corners for adequate coverage.

Even as pseudo-experts in the powder coat process, we still missed spots which then needed a second coat to cover. Once coated, bake for 15-20 minutes and that's it. You will have a glossy finish, which is corrosion resistant, scratch resistant, and is also UV resistant. We were able to fabricate and powder coat 39 brackets for 1/10 the cost of the same bracket, from a golf industry supplier.

If your course accessories look unsightly but are still useable, consider refinishing them by powder coating. It is very inexpensive to get started, and powder is no more expensive than the cheapest aerosol paint.

Yet the finish will last one or more seasons and comes in more colors and textures than you can imagine. By doing our own ball washers, we saved the course the US equivalent of£1312. By fabricating and powder coating our own brackets, we saved the equivalent of £500. Recoating the inside of the cups saved us the equivalent of £220 each time we would have replaced the cups. For the first season we saved Briarwood over £3125, while giving the course accessories a "factory fresh" look. I already own the powder coat gun, so our investment was small.

We already had the sandblasting cabinet, which speeds up the process, but is not necessary to have good results. Powder coating can be used on any metal part in your shop, on which you would like a durable, corrosion resistant finish. The limiting factor is the size of the oven and even that can be overcome by investing an infrared heat lamp.

You can check out the powder coat gun and supplies at www.electrostaticmajic.co.uk. There are other suppliers of DIY powder coat supplies, the previously mentioned supplier is the first one I came across while trying to convert this article to English.

If you would like specific questions answered you can e-mail me at briarmain@180com.net.

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