AVERTING A CRISIS

By David Venhuizen, P.E.

I took a cruise through Rimrock a few weeks ago and saw that all the houses going in there are served by "aerobic treatment unit" (ATU) systems, the effluent from which would be dispersed over the yard in a spray dispersal field. This is currently pretty much the "default" system in Hill Country developments. Here in Texas, the regulatory system is set up to preclude any meaningful observation of the performance of on-lot wastewater systems. However, wherever the performance of ATU's has been studied with any rigor, a high degree of non-compliance has been observed. Often this is blamed on failure to properly maintain the systems. In Texas, the degree of non-performance by ATU maintenance contractors is legend. So much so that a backlash against being required to pay for a maintenance contract but not receiving any service led to a law passing the last session of the Texas Legislature that allows home owners to conduct their own system maintenance.

In any case, the "maintenance" which is required does not entail activities which might "maintain" the system at any given performance level, rather the activities mostly just check operational status of the mechanical components. One example, although ATU operations and maintenance manuals typically stipulate that a "jar test" be conducted at every maintenance visit to determine if sludge should be removed, this does not appear to be routinely done. There is no place to report such an observation on the "official" TCEQ maintenance form. One maintenance contractor explicitly told me he does not execute that test, rather his criterion for pumping the system is when sludge starts to build up in the effluent pump chamber, a condition that would indicate the system has been failing for some time. He stated that this results in pumping about every 5 years. EPA states that sludge removal should be expected on intervals of "3-6 months". If you run the calculations, using "typical" factors stated by EPA, this interval indeed appears necessary.

But regardless of how diligent a maintenance contractor may be, he is only required to observe the system once every 4 months. EPA states that "Successful operation of ATUs depends on … good management that employs meaningful measurements of system performance at sufficiently frequent intervals to ascertain changes in system function." The minimal protocol specified by the Texas rules, which does not require *any* measurement of system performance, falls far short of this. EPA also states, "It is estimated that an effective [management] program will require between 12 and 28 person-hours annually …." This is a far cry from the 3-4 hours typically applied.

The nature of the base technology of an ATU—activated sludge—is that its performance can change in short order, subject to the operating conditions. As EPA states, the treatment system is "sensitive to temperature, power interruptions, influent variability, and shock loadings of toxic chemicals [including routinely used household cleaning agents and laundry bleach]." Activated sludge technology is inherently unstable because it depends for its treatment action on very few trophic levels of organisms living in concentrations far higher than found anywhere in nature (a trophic level is a rung on the food chain—organisms on a higher trophic level eat organisms on a lower trophic level), thus it is a very truncated ecology that is not inherently sustainable. The process can only be kept "on track" by maintaining proper operating conditions with constant inputs of energy to aerate the wastewater and monitoring the process to maintain proper food/microorganism levels – the point of that “jar test”. In the on-lot environment, conditions are constantly changing, since flows into the system are episodic, in response to water using activities in the home. So the ATU is operating “on the edge” even under the best of conditions.

This, far more than whether or not the very minimal required maintenance protocol is properly executed, is the reason why studies of ATU’s routinely observe a high degree of non-compliance. And when ATU’s are “off track”, this often creates odors. Since air is being pumped into the wastewater to aerate it, that air has to vent, so any “upset” condition is quite likely to result in odors being detected.

Turning to the spray dispersal system, the idea inherent in the ATU/spray concept is that the effluent would be disinfected before it is sprayed out onto the yard. This disinfection is almost universally accomplished (a more correct term would be “attempted”) with a drop-feed tablet chlorinator. Very poor dose control is afforded by this device—as EPA states, “These units have a history of erratic dosage ….”—so expecting good and consistent disinfection from it is a bit of wishful thinking to begin with. But when the ATU has done a poor job and there are non-compliant levels of solids in the effluent, disinfection is an illusion—again, to cite EPA, “Performance is dependent on pretreatment ….” The observed results are not encouraging. According to EPA, “Another field study of tablet chlorinators following biological treatment units [ATU’s] exceeded a standard of 200 FC/100 mL 93 percent of the time. No chlorine residual was present in 68 percent of the samples. Newer units managed by the biological unit manufacturer fared only slightly better. Problems were related to TSS accumulation in the chlorinator, tablet caking, failure of the tablet to drop into the sleeve, and failure to maintain the tablet supply.”

Regarding that latter problem, the maintenance of chlorine tablets in the chlorinators is explicitly defined as not-maintenance by TCEQ, so the homeowner rather than the maintenance contractor is expected to assure the unit is always supplied with chlorine tablets. With predictable results. One study done around Lake Livingston found that 15% of the units had no chlorine in them, and 85% had malfunctions—including stocking the chlorinators with the wrong type of chlorine tablet—that significantly impacted on disinfection ability. This blind eye toward this critical maintenance function seems to me to be a gross dereliction of duty by the regulatory system, one that can severely impact on the actual quality of water sprayed over any yard in the neighborhood.

So back to Rimrock—or any other upscale development in the Hill Country. Doesn’t it seem, well, questionable that those builders would ask around a half million dollars—significantly more in some developments—for a house and then saddle the owner with that sort of system, intermittently causing a literal stink and spewing questionably treated—and even more highly questionably disinfected—effluent over the yard where their children or grandchildren play? Sure the builder has an incentive to use the cheapest sort of system that he can get permitted. And indeed the permitting system is quite blind, quite intentionally so, to the problematic nature of the ATU/spray concept, quite willing to simply accept that all is “okay” simply because the rule system is set up to avoid asking any inconvenient questions about what is actually happening out there in the yard.

But it does seem that the buyer would like to know if there are options and, in the overall scheme of things, as a percentage of that half million dollar pricetag, what would be the cost impacts of employing them instead of the ATU/spray system. One expects that the only reason they don’t ask about it is that they don’t know that there *are* options. Most of them are likely moving out of cities, where their wastewater flowed into the city sewer system, and all they knew about it was that the toilet flushed and the bill came. They do not have any basis for differentiating between various on-lot wastewater system concepts.

So it would seem that an educational effort is needed. The first step in that educational process is to convey to the builders and prospective clients information about options. It is my belief that the most consistent and reliable sort of treatment process for producing high quality effluent under the operating conditions of the on-lot environment is offered by recirculating sand filter (RSF) technology, a technology which an EPA report states is "… ideally suited to rural communities, small clusters of homes, individual residences and business establishments. [This process] can achieve advanced secondary or even tertiary levels of treatment consistently with a minimum of attention." This process is inherently stable, thus highly robust, much more able to accommodate the vagaries of the on-lot operating environment. Since, as it is almost universally practiced these days, the filter media is fine gravel rather than sand, the term often used instead is recirculating gravel filter (RGF). I have engineered a variant of this technology, which I have termed the "high performance biofiltration (HPB) concept", that is even more stable and robust.

In the RGF process, the treatment effect is provided in a filter bed, which is intermittently dosed and through which the water drains by gravity. While there is a filtration effect, the major treatment effect is accomplished by microbes that live on the filter media, a process quite similar to that occurring in a soil drainfield. The filter bed supports a rich and diverse ecology, so the process is inherently stable, as long as it is loaded at a proper rate. The HPB process is designed to assure *uniform* loading of the filter bed every day, regardless of the flow rate that day from the house, at that proper rate, enhancing the consistency of the treatment process.

Note that power is needed only to distribute water over the top of the filter bed; the inherent treatment process is passive. In the event of a power outage or pump failure, the filter bed sits there patiently waiting, and then continues treatment without missing a beat when the power is restored. This contrasts sharply with the ATU, in which a power outage or loss of compressor function may cripple the treatment process, and there would be a period of poor treatment once power was restored or the compressor was replaced. Even more critically, ATU systems allow wastewater to just flow on through all during the time that the system is not functioning, running water with NO treatment directly into the effluent tank. In the HPB unit, that water is held in the system until function of the filter bed dosing pump is restored—nothing gets out of the system that has not passed through the filter bed.

While the effluent from this process could be readily disinfected—I would urge the use of UV rather than chlorine disinfection, as that would be more consistent and have a lower life-cycle cost than a drop-feed tablet chlorinator—in most cases I would urge routing this effluent to a subsurface drip irrigation field, for three reasons:

1. Since the water is injected underground, there is no need for disinfection, saving the money and operational hassle of that process, and obviating the liability of spraying the wastewater over areas where people and pets would be exposed to it.
2. If the drip irrigation field is designed to serve the high value landscaping on the site, it drought-proofs that landscaping, since this irrigation system would be immune to water use restrictions imposed during a drought.

3. Whatever contribution to the total irrigation water budget is contributed by the effluent in this drip irrigation system is a savings in dollars to the system owner and a service to the local and regional water economy, thus benefiting the community at large as well.

This highlights that the drip irrigation dispersal field indeed delivers a positive irrigation benefit, and that it can—and should—be designed and placed to maximize that benefit on each lot. The drip hose can be fit into all manner of spaces that would not be amenable to a "drainfield"—the possibilities are limited only by the imagination. Subsurface drip irrigation also maximizes the efficiency of the irrigation process, and that imparts greater water use efficiency, further defraying water demanded for irrigation.

The drip irrigation field will cost more than a spray dispersal system, of course, but as shown on the attached spreadsheet, on a life-cycle cost basis, drip would be less expensive than spray due the avoided cost of chlorine and savings in water costs. The latter assumes the owner's water is delivered by a piped water system, of course. If it came from a well or a rainwater system, then an explicit monthly water cost would not be seen by the owner. However, if the source were a rainwater system, using treated effluent to defray outdoor water demands would be a very valuable contribution to making the rainwater system more drought-tolerant.

The first question either the builder or the buyer will ask, of course, is, "How much more will it cost?" That is a difficult question to answer at this point. As with anything that is "non-standard" vs. an action that is routine, there is a cost penalty inherent in the very fact that the non-standard course of action is unfamiliar. Therefore, there is a "hump" to be gotten over before a "true" cost comparison can be offered, at the point when the RGF is an established "product" that is addressed by installers as routinely as the ATU is now. As noted, the drip irrigation field vs. the spray field will always increase the cost, regardless of how routine drip field installation may become, but as also noted, benefits of drip irrigation may totally negate that cost increase.

So let's confine the discussion to the costs of the treatment unit, with the understanding that drip vs. spray is a decision with important dimensions other than the initial cost. Attached is a spreadsheet reviewing the relative costs of an ATU and an HPB (RGF) unit. Based on the assumptions used, it is seen that the installed cost of an HPB unit could be $4,000 higher than the installed cost of an ATU and the HPB system would still have a lower life-cycle cost. So we need to consider two questions: (1) What would be the actual cost premium for an HPB unit vs. an ATU? and (2) Would people pay more up front to save money over the long haul?

Regarding the second question, we can be pretty certain that, left to his own criteria, the builder would never choose the lower life-cycle cost because the builder doesn't realize the long-run savings. So this factor would be subject to the mindset of the each buyer. Thus, it is the subject of educational and marketing campaigns, also understanding that issues other than raw cost come into play, as reviewed further below.

Regarding that first question, I am working on a production system that can deliver a product package which will put the RGF on a similar basis to an ATU, as far as convenience of the owner and/or installer is concerned. Again, until we get over that "hump" the actual cost bump could be considerable. However, once at least one installer gets "comfortable" with the RGF concept and adept at dealing with the product package, the premium cost should be well reflected by the difference in the cost of the RGF package vs. the ATU equipment and any extra effort required to excavate for, set, backfill, connect, and wire up the RGF unit.

Presently, it is estimated that the equipment package for an RGF unit would cost something in the range of $3,000 more than an ATU unit. The septic tank and pump tank entailed by an RGF unit may require a larger excavation than does the tankage for an ATU unit. This depends on the configuration of the ATU, understanding that it requires a "trash tank"—a small septic tank—in front of it, and the same sort of effluent tank that is in the RGF package. The RGF also includes the filter bed containment tank, but this is typically set somewhat less deep than the other tanks, so the amount of additional excavation required would not be like setting a whole extra tank. The extra excavation cost entailed would, of course, be impacted by the digging conditions. Connecting the tanks together would entail a bit more piping during installation than for the ATU. The wiring labor would be roughly equivalent, once the installer was familiar with the RGF control system. All in all, a $1,000 bump in installation cost may be about right, but again that remains to be demonstrated. If that is so, then a $4,000 cost premium for an RGF unit over an ATU unit would be fairly accurate. This would result in about an additional $25/month on the mortgage payment, a very minimal impact on the household budget, and essentially unnoticeable to a buyer who could afford a half million dollar house to begin with.

So the question becomes, how would this additional cost be justified? There is the intrinsic value of doing a "better job" of protecting environmental values, of course, but that only goes so far, and may really resonate with only a small portion of the market. Perhaps the greatest selling point of an RGF/drip system vs. an ATU/spray system is the impact on what might be termed the "personal environment" of the owner and his family. This may indeed be highly valued by at least part of the market. Eventually, it may be valued by the builder as well. I wonder, if a buyer does have odor problems—or instances of gastro-intestinal distress that they connect to the ATU/spray system—might we see lawsuits against the builders for NOT making the options known and available to the buyers? As I understand it, a seller of a home has some responsibility for disclosing all the factors to the buyer that may reflect the quality of the purchase. Does the nature of the on-lot wastewater system rise to this level?

And if these ATU/spray systems perform as ATU's have everywhere else they have been closely observed, I foresee significant water quality—and maybe public health—problems as the watershed fills up with them, massed together lot after lot. For example, there are 675 lots in Rimrock. At full development, the total wastewater flow would be something like 200,000 gallons per day. It is interesting that we know there are many organizations/interest groups that would scream bloody murder if these developments were served by a collective system that featured treatment at this level and spray dispersal with questionable disinfection and no area controls, yet they silently accede to it as it happens one lot at a time. The saving grace is that the system is highly distributed, taking maximum advantage of the assimilative capacity of the soil/plant system, but I still expect that the mass loadings will become problematic at some system density in a watershed. And this would impact on the environment experienced by the homebuyers over the long term, quite apart from any impacts perceived directly on their lots.

Given that neither the regulatory system nor the building industry is willing to pony up the resources to actually evaluate just what the performance of the ATU/spray system is under the operating conditions in these developments, would it not be prudent to at the very least offer the RGF/drip concept as an option to homebuyers? The builders offer "upgrades" for all manner of other features

– countertops, cabinets, fixtures, flooring, molding, and so on – so this is not at all a foreign concept, not at all an extraordinary thing for a builder to consider. Until such an option is made widely available, there is no way to evaluate what percentage of the market would willingly pay the freight to not have to deal with the ATU/spray system.

In any case, there is a movement afoot to restrict spray dispersal. In Clay County, spray dispersal has been outrightly outlawed, deemed to be too problematic to be allowed, in favor of subsurface drip dispersal. We don't really need to go to that length to "reasonably" restrict spray dispersal. All we have to do is impose a setback from the sprayfield to the property line that is "meaningful". The present requirement of 20 feet is a cruel joke on the neighborhood. I have suggested 200 feet, a distance that has some meaning in terms of aerosol drift, the idea being that if an owner chooses to put up with the hazards of spray dispersal, those hazards should be restricted to his property, not spread around to the neighboring properties, whether the neighbors like it or not. If a 200-foot setback were imposed, then spray would be restricted to very large lots, probably about 5 acres minimum, which is where it belongs, not lined up lot after lot in suburban subdivisions. So far, the proposal in the Hays County rules revision is to increase the setback to 40 feet. At the least this indicates awareness that this IS an issue.

Of course, a drip dispersal system could be used with an ATU as well. However, given the less consistent performance of an ATU—which is subject to episodes of solids "puking", as my realtor cousin once so colorfully put it—the cost of the drip system is likely to be somewhat higher than it would be when mated with an RGF unit. All manufacturers of drip field equipment—e.g., Perc-Rite, Geoflow, American Manufacturing—sell systems entailing a complex filtering and flushing unit, which presume that the consistency of pretreatment is poor. These units add many hundreds of dollars to the price of a drip dispersal system. The experience with drip behind RGF treatment systems is that this equipment is not needed. A simple filter, manually cleaned on several-month intervals—the normal maintenance cycle already imposed by the rules—is all that is needed to fully protect the drip emitters from clogging.

Considering all these factors, the progressive builder will be interested in getting "ahead of the curve" and will be interested in learning about—and offering—options that are more benign. As will the buyer of an expensive home in an upscale subdivision. The RGF/drip concept offers a superior option, for all the reasons outlined above. The merit of this would be enhanced for builders who are interested in attaining a high "green builder" rating. The Austin Green Building rating program, which is being extended into Hill Country watersheds, will offer "extra" points for systems that achieve beneficial reuse of the "waste" water, in recognition of the benefit of this type of system to the local and regional water economy. Not to mention that, as the attached spreadsheet shows, the RGF system would consume far less energy than does an ATU.

Given that going to such a more benign on-lot wastewater system would blunt environmental and public health impacts—that may become quite noticeable if the watershed fills up with ATU/spray systems—this only adds to the global value of offering options to the buyers of homes in Hill Country watersheds. Let the market do its work. Offer the options, educate the buyers on the issues. In the end, this may be the way—the least cost way—that we avert a looming water quality and public health crisis in these watersheds.