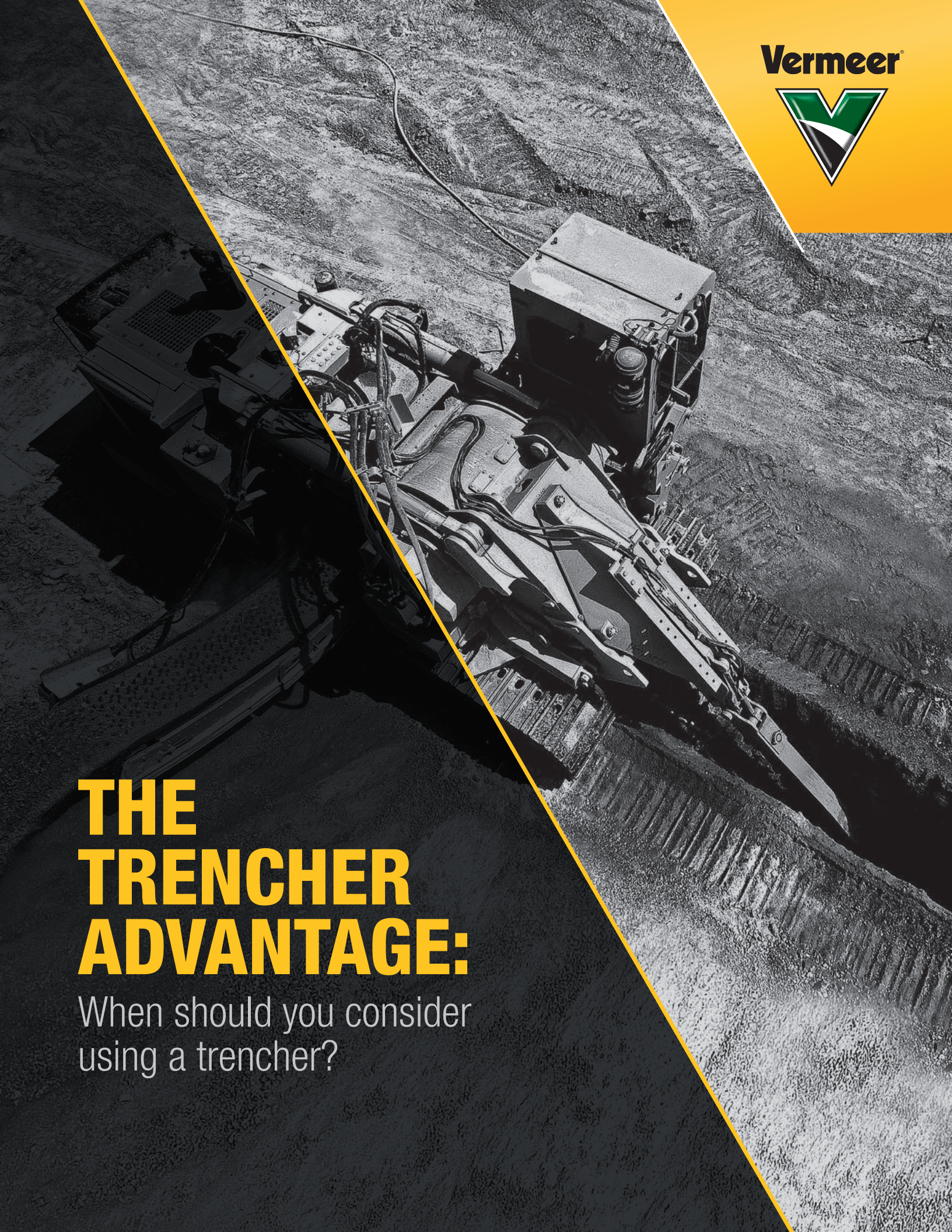
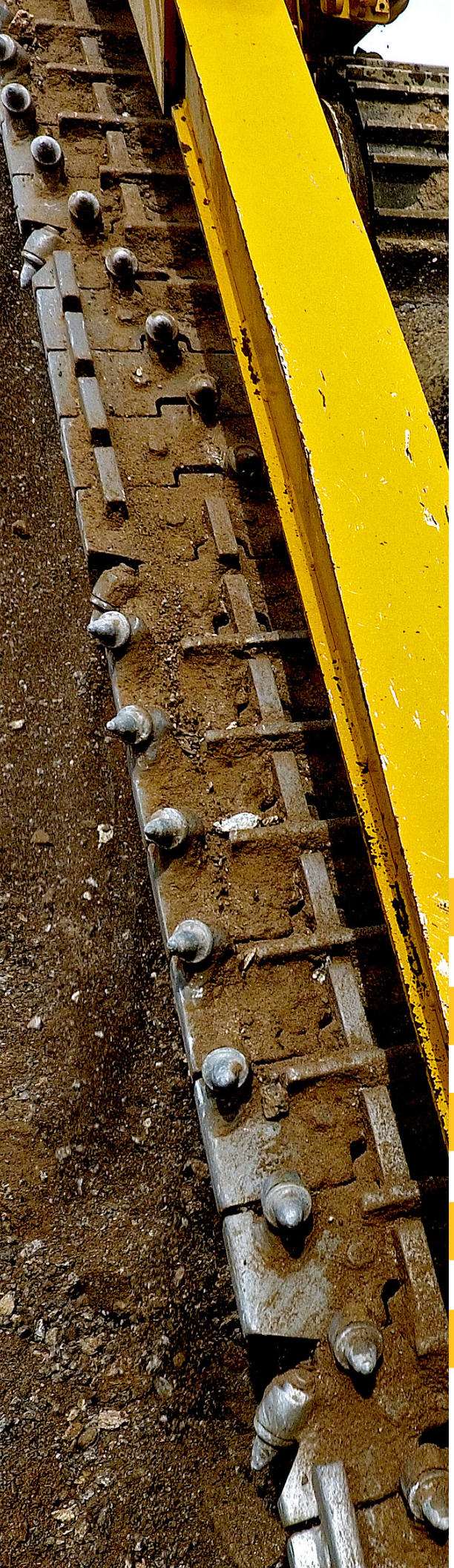


Vermeer

THE TRENCHER ADVANTAGE:

When should you consider using a trencher?



Abstract

Employing a trencher in unforgiving ground conditions can help a contractor trench more efficiently, produce fine fill dirt that can be dumped directly back into the trench and require less labor than the use of excavators. However, it is necessary to know when use of a trencher is needed. Also, knowing how to size and then configure a trencher for a particular job is critical to the success of a project. Finally, the pros and cons of renting versus purchasing must be considered. After consideration of these key points, this paper will present three different case studies in support of its conclusions.

Introduction

Many contractors use excavators to handle the bulk of trenching when laying pipe because the excavator is already in their fleet. However, excavators aren't always the optimal machine for the job, especially when working in challenging ground like rock and hard clays. Using excavators in such environments may create more work and put unnecessary wear on an excavator and the operator. In these conditions, it is wise to consider a trencher.

This important information is divided into five areas:

1. **When you should consider using a trencher instead of an excavator**
2. **How to size a trencher for your next project**
3. **Choosing, configuring and maintaining trencher teeth to optimize machine performance**
4. **Fleet options — buying versus renting a trencher**
5. **Case studies**

Part 1

When you should consider using a trencher instead of an excavator

Often, a contractor will install pipeline or other underground infrastructure with an excavator because they have always done so. Many may not even consider a trencher simply due to unfamiliarity. What incentives exist to tempt a contractor to break with tradition?

Continuous movement

When thinking about digging a ditch from Point A to Point B, a trencher and excavator are both designed to cut through and remove rocks or soils from the ground. But an excavator has to set up, dip, pull, swing, dump and repeat to do the job, and those repeated cycles take time. A trencher can remove the same rocks and soils in one continuous movement. In fact, in many scenarios and ground conditions, a trencher can work up to 3 - 4 times faster than an excavator.

Consistent and even ditch creation

Additionally, an excavator ditch will be wider at the top than it is at the bottom, resulting in the need for more backfill material. The trencher will leave the ditch clean with straight sidewalls and a flat, on-grade bottom. When properly sized, a trencher only excavates necessary material and can deposit spoil on either side of the trench. Those spoils can then be used as backfill in many cases.

A trench dug with an excavator may not have a flat and even bottom, and may have uneven walls. An uneven bottom results in the need for more bedding, which may add to the cost of the project. Uneven walls and inconsistent depths are also more likely to resist compaction and may increase surface patching costs. As the surrounding structure settles, surface sinking may occur.

Also, when excavator operators use a hammer attachment to break up rocky material and a bucket to remove it, the trench may be trapezoidal. This happens when an operator starts with a narrow point and then digs wider with the bucket to get deeper. In short, more material may be removed from the trench by an excavator than is necessary, adding to labor time and costs.

Reduced material handling

A track trencher excels in rocky conditions with its ability to efficiently cut rock of approximately 20,000 psi (137.9 MPa) and lower. An excavator bucket, however, often cannot dig rock of that specification. That means a contractor has to bring in a hammer attachment to break up the ground. Then a crew has to swap out that hammer with a bucket to dig the trench. Sometimes a contractor will have a separate machine to break the rock and another to dig the trench. Either way, that's extra time and equipment on the jobsite.

Also, an excavator often produces large chunks of material not suitable to be used as backfill. Suitable backfill often must be hauled in, adding to the time and cost of a job. However, with the proper configuration and the right teeth, a trencher will discharge small and consistent material that may be able to be used as backfill depending on the engineering specifications for the project.

Part 2

How to size a trencher for your next project

To determine the right size of trencher, the contractor needs to analyze the type of material the machine will be working in. Smaller, lower-horsepower machines are more effective with soil trenching, but as the relative hardness of the material increases, so do the demands on the machine. Trenching harder rock requires more weight and horsepower, and a properly sized trencher will handle a hard rock application better.

In soft or looser rock formations, crews can usually get by with a smaller trencher, but harder rock formations call for more horsepower. Using a small trencher in solid rock formations will take more time, and crews will go through more teeth in the process. Likewise, choosing a large trencher for digging in softer rocks will not increase production rates and can limit how narrow of a trench crews may be able to dig.

Depending on the application, bigger will not necessarily mean better. If a contractor does not have the expertise to properly match a trencher size to their particular application and conditions, experts from the trencher manufacturer should be consulted.

Part 3

Choosing, configuring and maintaining trencher teeth to optimize machine performance

To get the most performance from these powerful machines, there are a few critical steps subject matter experts recommend after having seen literally hundreds of trenchers in the field.

First, the contractor should be aware that different-sized trenchers take different-sized teeth. Therefore, it is vital the trencher have the correct teeth. The tooth shank for small- to mid-sized trenchers typically measures about 1 in (2.54 cm) in diameter from the base of the tooth to the retainer. And larger trenchers require the larger 1-1/2-in (3.81-cm) tooth shank to support the higher horsepower of those powerful trenchers.

Next, it is important to select the appropriate style of tooth for the ground conditions. Experienced trencher experts sometimes describe the available styles to a contractor as “sledgehammers and pickaxes.” The tip of a trencher’s tooth can range from rounded, dull surfaces to pointed, spiked styles. The rounded-face teeth with a larger carbide surface can hold up longer than more aggressive, smaller, carbide-tipped teeth. The teeth with a larger surface area are effective at breaking up softer rock formations like sandstone and limestone. For harder rocks, contractors should employ a more aggressive tooth style for deeper rock penetration.

Like a sledgehammer, teeth with a larger surface area can break the rock into large, thick sizes using less energy, that is, less horsepower. At the same time, the more aggressive pickaxe style produces smaller-sized material with each percussion and requires more energy or chain revolutions to dig. The smaller carbide-tipped teeth will help deliver a smooth cut surface, which makes them a good option for contractors trenching through concrete or asphalt and trying to limit spalling.

Once the tooth style has been chosen, it will be necessary to pick a tooth pattern. Each manufacturer has its unique approach. For the sake of this explanation, let’s look more closely at the Vermeer brand of trenchers:

- Their chains come with a standard V digging pattern, and the number of chevrons a chain has varies by the boom length and chain width. On wider chains, a chevron may start with a single center tooth and build to as many as three teeth on the outer plates. Each tooth bites off between 2 in and 4 in (5 cm and 10.1 cm) of material depending on the rock’s density.

- When a crew is working in very hard rock, they may want to consider using a staggered pattern that incorporates short and long teeth. For this pattern, longer teeth are placed in the middle of the chevron to make the initial impact, and then shorter teeth are used at the outer edges to pull the chips out of the way. Using a combination of smaller carbide-tipped teeth and larger-surfaced carbide teeth is also another combination often employed. This configuration mimics the way a person chews their food. Teeth in the middle cut, and the outer teeth grind and reduce the particle size.

Part 3

Choosing, configuring and maintaining trencher teeth to optimize machine performance

The next step in optimizing a trencher is, without a doubt, to verify the quality of the teeth being considered. There are many options to choose from in a wide range of prices. Experience has shown that just because a low-cost tooth may look identical to a more expensive one doesn't mean it will perform the same — and it is certainly unlikely to last as long.

Diligent tooth maintenance is also essential for maximum performance from a trencher. Each tooth in the pattern is designed to work in conjunction with the next one in the pattern, not the one beside it. When a tooth or several teeth are worn beyond their service life, it puts additional strain on the other teeth on the chain, pockets and the machine in general due to uneven cutting and additional vibration created by a missing or worn-down tooth.

Another consideration is that if a tooth is worn down too far, it will begin to wear into the pocket, causing the tooth to fall out, break off or realign itself. When this happens, the pocket itself will need to be replaced. Subject matter experts have found that while welding on a new pocket is a common occurrence in the field, it is usually avoidable.

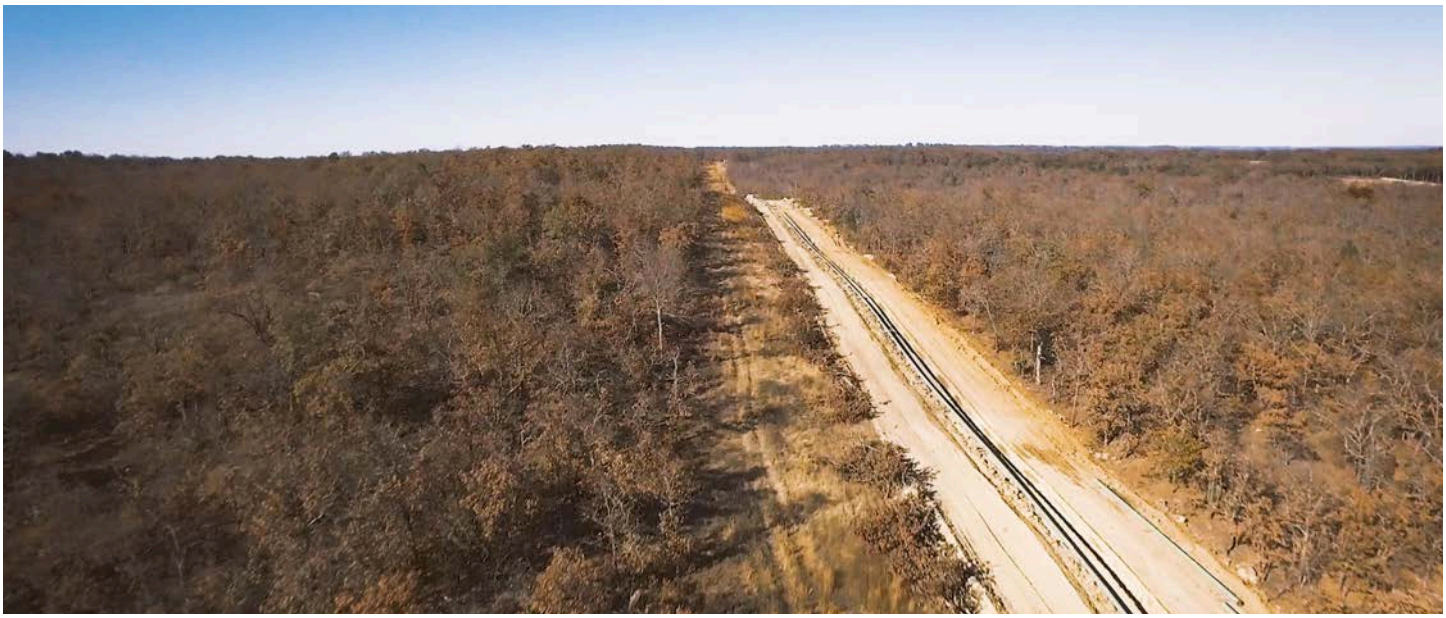
To help avoid premature wear, it is best to check the condition of the trencher's teeth regularly.

While there are many variables involved in choosing the right teeth to optimize the performance of trenchers, contractors should not feel they must figure out each complex step of the process on their own. The machine's manufacturer should be happy to assist.

Part 4 Fleet options — buying versus renting a trencher

Once a contractor has decided which trencher is right for their project and selected the proper configuration for the job at hand, the next decision is more financial, or budgetary, in nature. If intended to be operated on a consistent basis, especially when the contractor owns, operates and maintains a larger fleet of equipment, outright ownership is most likely the best fit. Another factor to consider is whether the trencher will be used frequently in the same ground conditions. If so, the contractor, regardless of size, should consider buying. On the other hand, if a company will use their trencher more sporadically or are working in different ground conditions frequently, renting from the dealer may be a more practical strategy. These trenchers are extremely specialized, so the dealer will likely be the only source for rental.

Part 5 Horizon Pipeline & Construction — oil and gas



One contractor involved with the construction of Targa Resources Corporation's massive Grand Prix Natural Gas Liquids (NGL) Pipeline was Horizon Pipeline & Construction, based in McAlester, Oklahoma. Established in 2015, the company employs a team of about 550 people.

Sandstone — and lots of it — was in store for the Horizon Pipeline crew on the Hickory Hills stretch of the Grand Prix Pipeline. Horizon Pipeline estimated that around 70% of the installation would be in rock and rough terrain. Horizon Pipeline typically subcontracts out any trenching or horizontal directional drilling (HDD) work on its projects. However, the team decided to rent a track trencher and perform all the open-cut work themselves, as the use of sub-contractors would be cost prohibitive.

After a bit of research, Horizon Pipeline settled on a Vermeer T855 Commander® 3 trencher rented from Vermeer Great Plains in Catoosa, Oklahoma. The crew used the T855III with an 8-ft (2.4-m) boom to cut a 36-in (91-cm) wide trench 5 ft (1.5 m) deep before laying the 10-in (25.4-cm) steel NGL pipeline. In common ground conditions for the area, they were able to open 1,500 ft to 2,500 ft (457 m to 762 m) a day. When working in harder rock, production slowed to between 800 ft and 1,200 ft (243.8 m and 365.8 m) a day.

While still hard at work on the Hickory Hills section, Horizon Pipeline was awarded another project for the Grand Prix Pipeline Oklahoma extension — a 50-mi (80.5-km) stretch between Velma and Davis, Oklahoma. Crews wrapped up the Hickory Hills job and the 50-mi (80.5-km) stretch in about nine months despite mainly weather-related setbacks. The team used the T855III on the 50-mi (80.5-km) project, where it was used to dig another 30,000 ft (9,144 m).

Part 5 Seller and Sons Inc. — water

Sellers and Sons Inc. is a general contractor with locations in Tucson and Phoenix, Arizona, that decided to diversify into underground utility work.

That diversification opened new opportunities for Sellers and Sons. One opportunity was the installation of water lines for the Phoenix-area municipality Goodyear. Specifically, Goodyear required the installation for their largest new planned community at the time, Estrella. At just over 20,000 ac (8,093.7 ha), Estrella is in the foothills of the Sierra Estrella Mountains in the Sonoran Desert Valley. The affluent community had just over 14,000 residents at the time of the water installation but is now home to a population of more than 100,000.

To prepare for that growth, Sellers and Sons installed 3,900 ft (1,188 m) of 16-in (40.6-cm) diameter ductile iron water pipe alongside a major thoroughfare, Estrella Parkway, that adjoins areas where residential subdivisions would later be built. The new line was installed at depths of up to 16 ft (4.9 m). The crew also ran a shallower trench parallel to the water line ditch for a future electrical line.

Projects like the Estrella Parkway come with unique challenges, namely frequent encounters with underground rock formations. It's so common in this area that underground contractors often include "rock clauses" in contracts that cover potential additional labor costs when facing unexpected granite and other rock formations while digging.

Sellers and Sons had done a lot of work in the area, usually with excavators, and knew they would be digging in a mixture of granite and dense blue granite. Experience informed them they would be lucky to dig 200 feet (61 m) in two weeks with excavators and hammers.

Sellers and Sons had rented trenchers from Vermeer Sales Southwest Inc. in the past, but they understood this project would be more challenging as it was entirely in rock. The team at Vermeer Mountain West pulled samples of the rock Sellers and Sons would be digging in, sent it off to be analyzed, then came back with an equipment recommendation to help maximize productivity.

In the end, they recommended the Vermeer T1155 Commander 3 trencher with Kennametal RockRazor TS19C "X" cutting teeth to perform in the rocky ground conditions. This enabled them to trench between 600 ft and 800 ft (182 m and 244 m) per day. With a 540-hp (402-kW) engine, the trencher worked through both granite and blue granite formations at an aggressive pace.

Sellers and Sons completed trenching on the project in just over two weeks — a timeframe that impressed the customer, crew and other contractors working nearby.

Part 5 Huguelet Génie Civil SA

The terrain and geography around the village of Tavannes in the Jura Mountains in northwestern Switzerland often pose challenges for trenching and excavating jobs. The wide variety of soil conditions on jobsites in the northern reaches of the western Alps makes versatility an important trait in any excavation equipment. For this reason, utility contractor Huguelet Génie Civil SA contacted their Vermeer dealer to discuss trenchers.

The company purchased a T655 Commander 3 trencher. Besides the trencher, the machine offered two additional attachment options — rockwheel or bucket wheel — which allowed flexibility between different types of trenching jobs, ranging from narrow-cut to wide-cut jobs in changing conditions, including hard rock trenching.

The powertrain of the T655III was an attractive component as well. Huguelet Génie Civil SA knew they would depend upon the machine to perform on jobsites for days at a time and would need all the low-speed, high-torque capabilities the machine could offer. Finally, working in such varied terrain, they would need to frequently adjust the trenching chain speed and digging angle, and conveyor speed and location.

Once the machine was in the field, the contractor found that the trencher was often up to five times faster than the equipment they used prior to the purchase of the T655III.

On long jobs in steep terrain, the dual-track tilt undercarriage (tilt angle capacity 10.5 degrees) helped the tracks follow the contours of the field when another machine would have been idled. Another feature the contractor appreciated was the cross conveyor in the T655III. The system allows the operator to discharge trenched material on either side of the machine and at different velocities.

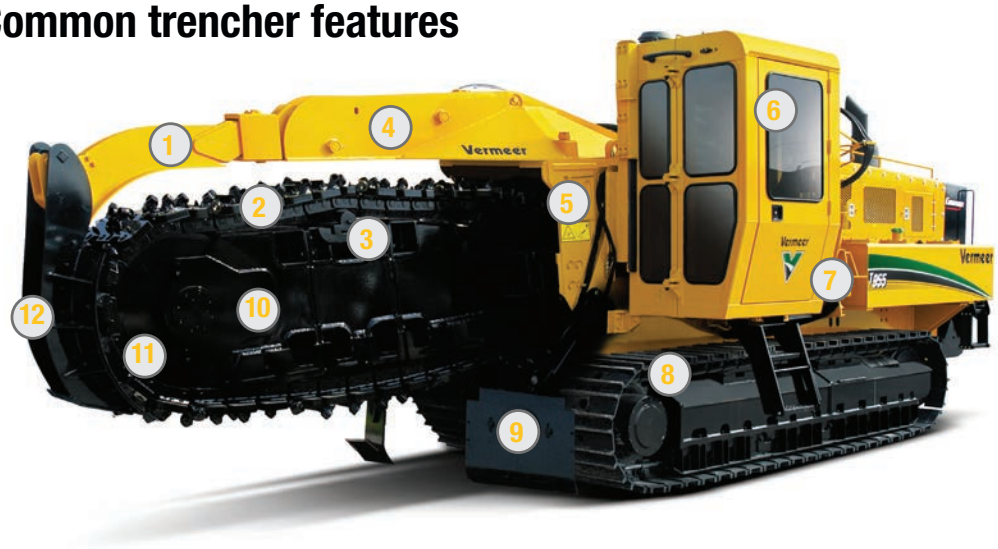
At the time, their best one-day result was around 656.1 ft (200 m), and they could depend upon a standard daily average of about 229.7 ft (70 m), including installing the pipe, backfilling and restoring the ground.

Conclusion

In conclusion, though excavators may be useful in many applications, it seems clear that a single, properly sized and configured trencher is ideal for many jobsites. Not only is the trencher fast, but the trench it cuts leaves the ditch bottom clean and ditch walls cleaner and straighter than those created with an excavator. Additionally, and of course depending on requirements, spoil can be used as backfill without crushing. It may not be necessary to make a capital expenditure to purchase a trencher if the situation indicates a rental will suffice.

As the case studies show quite plainly, the trencher can be especially effective in hard rock.

Common trencher features



1) Trencher cleaner arch
2) Teeth
3) Boom top rollers
4) Bridge
5) Boomhead
6) Cab
7) Cross conveyor
8) Tracks
9) Dirt drags
10) Trencher boom
11) End idler
12) Trench cleaner shoe

Vermeer SmartTEC

All Vermeer trenchers come equipped with SmartTEC performance software, a control platform that helps optimize productivity according to real-time machine control prompts. The platform is convenient to learn and operate, with user-friendly screens showing operators what adjustments can be made to maximize production and optimize performance as ground conditions change.

SmartTEC performance screens use CAN bus technology to continuously monitor machine performance data — providing proactive machine maintenance and operator performance analysis. The system also records machine performance for future analysis by the machine owner or fleet manager.