Reduce Total Project Costs with the Performance of Suction Excavation

A comparative cost analysis of hydro vac and suction excavation based on productivity and associated disposal costs.

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"Time is money'...waste it now. Pay for it later"

- Benjamin Franklin

Executive Summary

Advanced dry suction excavation technology, an innovative alternative to traditional water-based hydro vac equipment, is now considered the most economical and cost-effective choice as it relates to overall vacuum excavation project costs.

Utilizing tracking data obtained from an operator of a diversified fleet, operating both hydro vac and suction excavation equipment, comparative data analysis indicates that with suction excavation clients realize significant benefits and savings:

- ***45%*** faster head to head
- ***75%*** faster based on time onsite
- ***$976*** savings per day
- ***33%*** less environmental impact
- ***100%*** less slurry waste
- ***0*** gallons potable water used

Utility owners need to consider mandating suction excavation on certain projects, as they are ideally positioned to encourage the supplied service market to integrate true suction excavation equipment into existing fleets and offer the most cost-effective method of safe digging, allowing everyone to realize the benefits.

Introduction

Vacuum excavation equipment is currently used extensively throughout North America, allowing for safe and efficient excavation processes around sensitive buried infrastructure systems. Historically, this equipment was manufactured to operate primarily as a wet vacuum system, that is, the hydro vac.

As infrastructure owners mandate and enforce safe digging processes to ensure safety and prevent damage, the increase used of hydro vac excavation has resulted in a significant annual spend for end use clients. As disposal regulations increase, and disposal facility options decrease, these clients, including infrastructure owners, are faced with increased costs. Additionally, the environmental impact of traditional hydro vac water usage and slurry disposal has been subject to increased scrutiny, especially in relation to public perception and sustainable business practices. Progressive owners have identified this required safe excavation service as a site of potential cost savings and operational improvement.

The recent introduction of European suction excavation technology, based on an innovative dry approach with significant increases in power and performance that clearly differentiate the equipment from other options, is considered to be the most economical and cost-effective vacuum excavation choice available in the North American market. This paper will focus on the bottom-line value of this new technology, by comparing both hydro vac and suction excavation options from an end user total project cost perspective, rather than a simplistic hourly rate comparison.

“ ...the most economical and cost-effective vacuum excavation choice available in the North American market. ”

Methodology and Approach

In recent years, as vacuum excavation has increased in acceptance and use, the vacuum excavation industry has adopted a generally accepted billing model based on billed time and associated disposal fees (if applicable). Billed time generally factors in both onsite excavation, as well as logistics including travel to and from job and/or disposals sites. Disposal fees are flowed through to end user clients by contractors, often with an additional markup.

Analysis and comparison of specific completed work is difficult, recognizing that no two jobs are exactly alike, due to variables including but not limited to location, soil, site supervision, operator performance, and weather. Therefore, for the purposes of this cost comparison, we have chosen to direct our calculations at two scenarios we believe to be relevant and indicative of current vacuum excavation work in North America. Note, we recognize that vacuum excavation is often utilized on a variety of smaller jobs, however the variables of multisite locations and/or multiple clients are not reflective in our current data set and would limit our analysis at this point.

For an accurate cost assessment, two (2) hypothetical scenarios were created for a cost comparison between traditional hydro vac and advanced dry suction excavation technologies. Scenario A is based on a typical one day project requiring 150 cubic feet to be excavated; Scenario B is based on a large multi-day project requiring excavation of 5,000 cubic feet. (see Appendices A and B).

The previously indicated variables are accounted for by utilizing a statistically valid sample size for the data set to derive applicable dig rates for both hydro vac and suction excavation equipment. Equipment is assumed to be operated out of the same location, equalizing mobilization time to the job site. As is common practice, hydro vac slurry is considered to be disposed of at an offsite facility, while suction excavation spoils, being dry and unaltered, are assumed to be retained on the job site.

Comparative Data Sourcing

To accurately calculate costs of each hypothetical scenario, three key data points needed to be established for both hydro vac and suction excavation:

- Dig rate (cubic feet per hour)
- Hourly rate
- Cost per Disposal

The productivity indicator of 'dig rate' is utilized to establish required hours to complete the excavation per the project scope. This rate of production, or throughput, is calculated based on the time spent on site digging and the total amount of material moved per job, and was derived from data supplied by an established and well respected vacuum excavation supplied service operating organization, with an integrated fleet of both hydro vac and suction excavators. Data was obtained on site from over 3,000 jobs, by experienced operators through the use of hand- held devices, over the period of May 2019 to December 2019 (see Figure 1).

For our comparison, the dig rates established were:

- Hydro vac - 22.6 cubic feet per hour (CUF/HR)
- Suction Excavator -32.7 cubic feet per hour (CUF/HR)

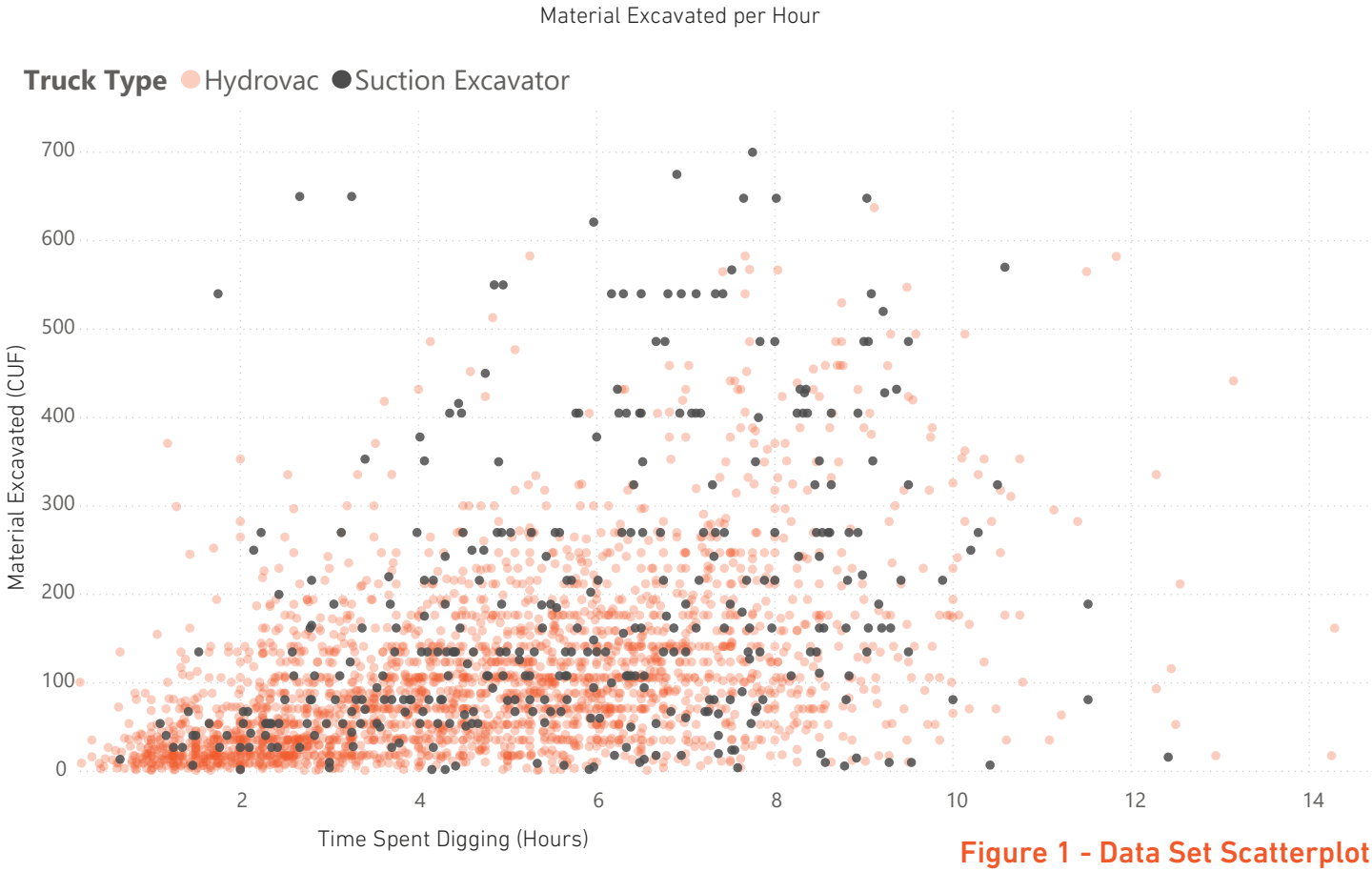

Figure 1 - Data Set Scatterplot

Utilization of a statistically sufficient data set supports the relevancy of this approach. The data set included in excess of 35,000 data points, including the variables of truck type, soil, total material, water usage (if required), arrival time, and departure time. Note, the data gathered is part of the company's overall billing process and as such is required to be accurate. All data associated with time, such as 'time on site', 'digging time', and 'disposal time', have been verified by GPS per the organization's billing procedures. Additionally, as part of the reporting process the operator has adjusted for site delays attributed to client direction, equipment and/or operator related issues.

Hydro vac equipment utilized within this data set comprise a variety of manufacturers, including Vactor and Rival, and are representative of commonly available hydro vac technology. Specialty, large, and/or custom equipment is excluded from analysis. All suction excavators are MTS Dino series models, similarly equipped, and available across North America.

Soil types included clay, gravel/screenings, grey clay (no rocks), grey clay (with rocks), red clay (no rocks) red clay (with rocks), regular soil, sand, sandy clay, thick shale, unshrinkable fill, and virgin clay. Note, for the purpose of analysis, several project types of been excluded as they are not indicative of commonly found, regular excavation sites.

Recognizing the potential for human error, outlier data was identified, examined and if determined to be a result of missing inputs and/or unreasonable reporting information levels,
all related job data was excluded.

For the remaining variables of Hourly Rate and Cost per Disposal, prevailing market rates were utilized.

Analysis and Results

Head to head, the data established that the suction excavator is proven to be 45% faster with respect to excavation rates. This ability to simply move more material every hour on site is a primary factor to overall performance, as demonstrated in both scenarios.

In Scenario A, the hypothetical job scope requires vacuum excavation of 150 ft3. Utilizing the suction excavator would allow the end client to realize savings of approximately 10% due to higher productivity as a direct result of the higher dig rate and the ability to leave excavated materials on site, avoiding travel to an offsite disposal facility and associated disposal charges/fees. Additionally, the suction excavator completed the project scope in 6.34 hours, while the hydro vac required 9.64 hours – time savings of 3.3 hours or 34%. The quicker job completion by the suction excavator may be seen as an additional benefit to the site owner as it reduces the potential time associated with site supervision and/or allows quicker implementation of the next phase of the project.

In Scenario B the project scope is expanded and requires vacuum excavation of 5,000 cubic feet, a multi-day project. As outlined in Appendix B, based on prevailing market rates for both hourly charges and disposal fees, the project costs associated with this example calculate to $98,049.00 for Hydro vac, and only $76,562.00 for suction excavation, a direct savings of $21,486.00 (22%) for the end client, $976.00 per day.

The suction excavator, maximizing daily onsite excavation time together with a higher dig rate, achieves a 75% increase in production, significantly reducing billable time, delivering faster project completion and reducing overall project costs.

By eliminating water, the suction excavator is capable of dumping dry, unaltered materials on the job site, unlike a hydro vac that is required to leave site, travel to a regulated facility to dispose of wet slurry, before travelling back to the job site to continue excavating. Additionally, the suction excavator does not need to fill or refill water to enable excavation. Within a workday, the hydro vac utilizes significant billable hours on non-excavation activity, while the suction excavator is able to remain at the job site all day, focused on production and job completion. In the multi-day project example, with a nine (9) hour workday, the suction excavator was able to devote over 80% of the billable hours directly to onsite performance. Over the course of the project, the hydro vac billed over forty-six (46) hours of offsite time.

In our example, a hydro vac would be expected to excavate 136 ft3 per day, requiring a total of thirty-seven (37) days for substantial completion. The suction excavator would be capable of excavating 237 ft3 per day, a 75% increase, and would require only twenty-two (22) days to complete the project. This is an overall project time reduction of fifteen (15) days, reducing overall projects costs. Additionally, this also assists the project owner with management of project timelines, optimizing all services and vendors, minimizing the risk associated with time delays and potential assessment of liquidated damages and/or levied fees due to project delays.

Utilizing the variables as posited in Scenario B, the value of suction excavation offers savings to the end client up to hourly rates of $513.00, or 28% above prevailing market rates. It is only when suction excavation rates exceed this premium that traditional hydro vac utilization offers the end client increased value at current market pricing. This further supports the necessity of focusing on total project costs and not merely assessing hourly rates.

Conclusion

Dry suction excavation offers the end client the ability to realize significant savings on all projects of 150 ft or greater, without compromising safety to workers, the public, or plant damage. By negating the requirement of water utilization with this dry option, time on site is maximized and material remains unaltered for potential reuse. On larger projects, requiring multiple days on site, savings continue to compound, and offer even greater savings to end use clients when considered on an annualized basis.

Additionally, dry suction excavation is considered to be more environmentally responsible, courtesy of a reduced carbon footprint, elimination of potable water resources for excavation, and the associated need of regulated disposal facilities. These facilities are often energy-intensive, utilizing a multi-step process to separate hydro vac slurry into constituent components. The resulting semi-solid material lacks structure and, with limited to no commercial value, is generally transported to landfill for final 'end of life' disposal.

It is also important to note that in this analysis the indicated cost savings are attributable to the higher productivity of specific European dry suction excavators. This equipment, reflective in our data set, is demonstrably different than previously available dry vacs which have not been factored into this comparative analysis as data is unavailable. The organization providing the data operates a fleet of MTS Dino Series suction excavators. This equipment is purpose built for dry suction excavation, and all units in their fleet are similarly equipped with patented twin fan technology, capable of generating air conveyance in excess of 24,000 CFM, powerful onboard air compressors, and a proprietary filtration system. Historically, 'dry vacs' have been limited in power and performance and considered inefficient and ineffective on all but the smallest and easiest of jobs. Current market alternatives are often merely modified hydro vacs units, with neither the power, nor the engineering and build quality, to offer MTS Dino Series equivalent productivity levels.

Vacuum excavation is a commodity in the construction and utility industry that has seen considerable growth in North America over the last 20 years. Suction excavation is slowly gaining traction, but adoption rates are still low as contractors and service providers remain committed to traditional hydro vac equipment options, and end use clients continuing to accept prevailing hydro vac service and disposal rates and thus, resultant overall project costs.

Utility owners need to consider mandating suction excavation on certain projects, as a safe digging practice which will result in less time for project completion, less travel on our roadways, less water consumption, less energy usage (vehicles and disposal facilities), less carbon emissions, and most significantly less cost. As industry drivers, infrastructure owners and other end clients are ideally positioned to encourage the supplied service market to integrate true suction excavation equipment into their existing fleets and offer the most cost-effective method of safe digging, allowing everyone to realize the benefits.

Job Scenario	
Total Material (CUF)	150

Hydrovac (HV)

Dig Rate (CUF/HR)	22.6	1
Hourly Rate	$ 245	2
Disposal Cost	$ 450	3

Load/Waterfill time	0.50	5
Drive to Site (hours)	0.75	5
Time on Site (hours)	6.64	4
Drive to Disposal	0.50	5
Disposal Time	0.75	5
Drive to Shop	0.50	5
Total Hours	9.64	

Truck Cost	$ 2,361
Disposal Cost	$ 450
Total Cost	$ 2,811

Cost/CUF	$ 18.74

Suction Excavator (SE)

Dig Rate (CUF/HR)	32.7	6
Hourly Rate	$ 400	6
Disposal Cost	$ -	8

Load/Waterfill time	0.25	10
Drive to Site (hours)	0.75	10
Time on Site (hours)	4.59	9
Drive to Disposal	0.00	10
Disposal Time	0.00	10
Drive to Shop	0.75	10
Total Hours	6.34	

Truck Cost	$ 2,535
Disposal Cost	$ -
Total Cost	$ 2,535

Cost/CUF	$ 16.90

Suction Excavator Savings		
	Savings	Savings %
Total $ saved	$ 276	10%
Total Hours Saved	3.30	34%

Notes:

1. HV Dig Rate – per data set;

2. HV Hour Rate - prevailing market pricing;

3. HV Disposal Cost - prevailing market pricing;

4. HV Time on Site - calculated based on material to be excavated;

5. HV time variables (estimated) - thirty (30) minutes for equipment loading and water fill; travel time to disposal location of thirty (30) minutes; an additional forty-five (45) minutes for material disposal activities; travel time from disposal location to original facility/depot of thirty (30) minutes;

6. SE Dig Rate – per data set;

7. SE Ho r Rate– prevailing market pricing;

8. SE Disposal Cost –material is assumed to be left on site;

9. SE Time on Site – calculated based on material to be excavated at suction excavator dig rate of 32.7 ft3 per hour;

10. SE time variables (estimated) - fifteen (15) minutes for equipment loading only as water is not required; forty-five (45) minutes travel time to return to original facility –same as original time to site. Note, as material is dry, it is assumed to be left on site, negating the time required to travel to an approved disposal facility, and associated disposal fees.

Job Scenario	
Total Material (CUF)	5,000
Working hours/day	9

Hydrovac (HV)

Dig Rate (CUF/HR)	22.6	1
Hourly Rate	$ 245	2
Cost per Disposal	$ 450	3

Avg Hours per Day		
Load/Waterfill time	0.50	5
Drive to Site (hours)	0.75	5
Time on Site (hours)	6.00	4
Drive to Disposal	0.50	5
Disposal Time	0.75	5
Drive to Shop	0.50	5

Project Totals		
CUF/Day	136	6
# of days	37	7

Total Hours	332
Total # of disposals	37

Truck Cost	$ 81,399
Disposal Cost	$ 16,650
Total Cost	$ 98,049

Cost/CUF	$ 19.61

Suction Excavator (SE)

Dig Rate (CUF/HR)	32.7	8
Hourly Rate	$ 400	9
Cost per Disposal	$ -	10

Avg Hours per Day		
Load/Waterfill time	0.25	12
Drive to Site (hours)	0.75	12
Time on Site (hours)	7.25	11
Drive to Disposal	0.00	12
Disposal Time	0.00	12
Drive to Shop	0.75	12

Project Totals		
CUF/Day	237	13
# of days	22	14

Total Hours	191
Total # of disposals	-

Truck Cost	$ 76,562
Disposal Cost	$ -
Total Cost	$ 76,562

Cost/CUF	$ 15.31

Suction Excavator Savings		
	Savings	Savings %
Total $ saved	$ 21,486	22%
Total Days Saved	15	

Notes:

1. *HV Dig Rate – per data set;*
2. *HV Hour Rate - prevailing market pricing;*
3. *HV Disposal Cost - prevailing market pricing;*
4. *HV Time on Site – excavation time available within working hours*
5. *HV time variables (estimated) - thirty (30) minutes for equipment loading and water fill; travel time to disposal location of thirty (30) minutes; an additional forty-five (45) minutes for material disposal activities; travel time from disposal location to original facility/depot of thirty (30) minutes;*
6. *Expected Daily HV Production – based on available hours and dig rate;*
7. *Days to complete Project – based on expected daily production and total materials per project scope;*
8. *SE Dig Rate – per data set;*
9. *SE Hour Rate– prevailing market pricing;*
10. *SE Disposal Cost –material is assumed to be left on site;*
11. *SE Time on Site – excavation time available within working hours*
12. *SE time variables (estimated) - fifteen (15) minutes for equipment loading only as water is not required; forty-five (45) minutes travel time to return to original facility –same as original time to site. Note, as material is dry, it is assumed to be left on site, negating the time required to travel to an approved disposal facility, and associated disposal fees.*
13. *Expected Daily HV Production – based on available hours and dig rate;*
14. *Days to complete Project – based on expected daily production and total materials per project scope.*