Nova efikasna mašina za valjanje rupa tokom postavljanja podzemnih komunikacija u urbanoj izgradnji

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U radu je prikazan postupak razvoja i testiranja novih mašina za ugradnju podzemnih komunikacija u uslovima urbane izgradnje. Takođe, date su ostvarene prednosti: zaštita životne sredine, odsustvo štetnih efekata dinamike, visoke performanse i ekonomičnost.

Ključne reči: ugradnja podzemnih komunikacija, metode, optimalni parametri

1. UVODNA RAZMATRANJA

Instaliranje podzemnih komunikacija za različitu namenu (sistem za snabdevanje gasom i vodom, kanalizacija, sistem grejanja, strujni i komunikacioni kablovi itd.) u uslovima urbane izgradnje često se izvode ispod postojećih puteva i železničke i tramvajske infrastrukture, gradskih ulica i trgova, zgrada i konstrukcija za koje se koriste posebne zatvorene metode ugradnje.

Trenutno, najčešći načini postavljanja podzemne komunikacije su horizontalno mehaničko bušenje, prodiranje i probijanje. Na Moskovskom državnom građevinskom univerzitetu (MSCU) tj. na Katedri za tehnologiju, mehanizaciju i gradske saobraćajnice u tu svrhu razvijena je nova efikasnija mašina za valjanje rupa.

2. PRIKAZ GLAVNIH METODA UGRADNJE PODZEMNIH KOMUNIKACIJA

Metod horizontalnog bušenja namenjen je za postavljanje cevi i zaštitnih kućišta za postavljanje radnih cevi, kablova i drugih komunikacija ispod automobilske i železničke infrastrukture. Mašine, zasnovane po ovom principu, omogućuju polaganje zaštitnih kućišta i cevi prečnika 325 ... 1420 mm i maksimalne dužine polaganja 40 ... 60 m. Brzina postavljanja bira se prema specifičnim uslovima rada, i to: 2 ... 5,5 m / sat kod konstrukcije objekta u zemljištu srednje gustine i 1,8 ... 3,5 m / sat - u teškom tlu.

Pri polaganju cevi metodom prodiranja rupe se formiraju radijalnim zamenom i konsolidacijom tla (bez njegovog razvoja) položene cevi ili radnog tela. Razlikuju se mehanički i vibro postupak pri čemu se poslednji pristup koristi češće.

Vibro postupak se primenjuje kod polaganja cevovoda u peščanom i peskovitom zemljištu zasićenom vodom u kojem je nemoguće napraviti stabilnu rupu, pa je mehanički probijanje snažno komplikovano ili gotovo nemoguće zbog velikog otpora kretanja cevi zakrčene zemljom. Ovako postavljene ležeće cevi su prečnika do 2600 mm i dužine do 25 ... 50 m. Brzina postavljanja zavisi od uslova tla i prečnika postavljene cevi i prosečno je 20 ... 60m / h.

Metodom probijanja vrši se polaganjem u tlo I-III kategorije čeličnih cevovoda prečnika 529 ... 1720 mm, a

kao kombinovani armirano betonski kolektori za nalivanje u dužinu od 60 ... 80m. Pri probijanju cevovoda (kućišta) utiskuje se u tlo, otvoreni kraj opremljen prstenastim nožem, a zemlja koja pristiže u glavnu vezu, skuplja se i odvodi mehanički preko položenog cevovoda. Kao uređaji za probijanje koriste se hidraulične dizalice.

Brzina postavljanja za ovaj način zavisi od fizičko-mehaničkih svojstava tla, prečnika i opsega cevovoda, snage dizalice i od načina razvoja i uklanjanja tla i prosečno je 0,5 ... 1,5m / sat. Izborom optimalnih zatvorenih metoda ugradnje definisane su geometrijske dimenzije, svrha i dubina polaganja komunikacija, lokacija, količina i uslovi tla, značaj konstrukcije za odvođenje i postojeće komunikacije.

3. UGRADNJA PODZEMNIH KOMUNIKACIJA MAŠINOM ZA VALJANJE RUPA

U MSCU-u na Katedri za tehnologiju, mehanizaciju i gradske saobraćajnice, razvijena je nova, efikasnija mašina za valjanje rupa za zatvorene instalacije podzemnih komunikacija [2,3]. Ova mašina nazvana raskatčik i može se upotrebiti za formiranje horizontalnih, vertikalnih i odstupljenih rupa.

Formiranje rupa na ovaj način predstavlja kontinuirani proces u kojem se deformacijom i koncentrisanjem zemljišta stvara cilindrična šupljina uz pomoć mehanizma za odmotavanje. Ovaj uređaj se sastoji od više koničnih članaka koji slobodno rotiraju na osovini. Osa članka pomerena je za ugao i pomera se u odnosu na osu uređaja tako da se članci kreću po spirali. Pri rotaciji i aksijalnom pomeranju uređaja, članci u tlu formiraju rupu. Svaki članak ulazi u rupu formiranu od prethodnog članka i na taj način povećava prečnik rupe. Zemlja se gomila u radijalnom pravcu, a oko rupe formira gustu zonu prečnika 3-4 prečnika rupe.

Formiranje rupe ovim uređajem odgovara površinskom sabijanju zemlje pri čemu je svaki naredni članak teži od prethodnog.

Za razliku od tradicionalnih metoda formiranja rupa pri kojima se otkopana zemlja izvodi na površinu, navedeni uređaj sabija zemlju u zidove rupa. Na taj način omogućava formiranje stabilnog cilindričnog otvora u koji se mogu postaviti komunikacije različitih namena.

Postoje 3 glavna dela mašine za valjanje rupa (sl.1):

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1. pogonska jedinica (rezervoar za ulje);
2. jedinica za bušenje sa daljinskim upravljanjem;
3. radno telo (raskatchik).

Prednosti mašine za valjanje rupa:

- a) nedostatak vibracija i buke prilikom bušenja;
- b) mogućnost formiranja rupa velikog prečnika (do 1 m) i dužine do 50m;
- c) velika brzina bušenja (10 ... 20m / sat).

Slika 1: Mašina za valjanje rupa

Slika 2: Formiranje rupa mašinom za valjanje rupa

Slika : Obnavljanje cevovoda korišćenjem mašine za valjanje rupa

Mašina može da radi u urbanim gradskim uslovima i formira rupe bez uklanjanja zemlje. Zatvoreni cevovodi, kablovi, zamena starih cevi (slika 2-3) - ovo je lista glavnih radova izvedenih korišćenjem raskatchik.

4. ZAKLJUČAK

Testiranja sprovedena u realnom okruženju mašina za valjanje rupa pokazuje njegove performanse i identifikuje brojne prednosti u poređenju sa drugim sličnim mašinama, i to: 1. Bezbednost životne sredine, nedostatak buke i štetnih uticaja na rukovaoca i životnu sredinu; 2. Veća produktivnost zbog činjenice da tokom stvaranja rupa ne dolazi do izvlačenja tla napolje i smanjenog vremena ciklusa; 3. Značajan ekonomski efekat zbog niske potrošnje energije procesa valjanja kao i radne snage.

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- [3] Patent of the Russian Federation for the invention № 238687 " Raskatchik toform a holes in the ground". priority from 14.11.2008. (authors: A.I. Dotsenko).

New Effective Machine for Rolling Holes During Installing Underground Communications in Urban Construction

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Designed and tested a new machine for installing underground communications in urban construction. Its benefits: environmental security, the absence of harmful effects of dynamic, high performance, cost-effectiveness.

Keywords: installing underground communications, methods, raskatchik, optimal parameters

1. INTRODUCTION

Installing underground communications of different function (gas and water supply system, sewerage, heating systems, electricity and communications cables, etc.) in the conditions of city construction often produce under the existing roads and railways, tramways, city street and the squares, buildings and structures for what the special closed installation methods are used.

The most common methods of closing laying underground communication are now horizontal mechanical drilling, piercing and punching. In the Moscow State Construction University (MSCU) at the chair Department of Technology, mechanization and operation of urban roads for this purpose developed a new more effective machine for rolling holes.

2. SUMMARY OF MAIN METHODS INSTALLING UNDERGROUND COMMUNICATIONS

Method of horizontal drilling lay under automobile and the railroads pipelines and protective cases for placement of working pipelines in them, cables and other communications.

Machines, working by this principle, provide laying in soil I-IV of category of pipes casings under pipelines with a diameter of 325 ... 1420 mm with the maximum length of laying 40 ... 60m. Speed of a driving choose according to specific conditions of work, namely: 2 ... 5,5m/hour at an object construction in soil of average density and 1,8 ... 3,5m/hour – in heavy soil. When laying pipes by a piercing method formation of holes carry out due to radial replacement and soil consolidation (without its development) a laid pipe or working body. Distinguish a piercing mechanical and a vibro-piercing at what the last is used more often.

Vibro-piercing apply when laying pipelines in sandy and sandy water-saturated soil in which it is impossible to receive a steady hole and therefore the mechanical piercing is strongly complicated or almost impossible because of big resistance of movements of the pipe clamped by soil. Vibro-piercing lay pipes with a diameter up to 426 mm at the length up to 25 ... 50m. Speed of a driving depends on soil conditions and diameter of a laid pipe and corresponds on the average 20 ... 60m/h.

Method of punching carry out laying in soil I-III of categories of steel pipelines with a diameter of 529 ... 1720

mm, and as combined ferroconcrete collectors of casting appointment to length of 60 ... 80m. At punching the pipeline (case) press into the soil massif the open end supplied with a ring knife, and the soil arriving in a head link, develop and delete via the laid pipeline in the mechanized way. As the punching devices used hydraulic jacks. Driving speed for a method of punching depends on physic mechanical properties of soil, diameter and extent of the pipeline, power of jacks and as from a way of development and removal of soil and averages 0,5 ... 1,5m/hour.

Selecting the optimal closed installation methods defined geometrical dimensions, purpose and depth of laying communications, location, extent and soil conditions it runs, character recut structures and existing communications.

3. CLOSED INSTALLING UNDERGROUND COMMUNICATIONS BY MACHINE FOR ROLLING HOLES.

In MSCU at the chair of Technology, mechanization and operation of urban roads a new, more effective machine for rolling holes, is developed for closed installation underground communications [2,3]. This machine is called raskatchik soil and can be used for forming the horizontal, vertical and deviated holes.

The formation of the hole in this way is a continuous process in which the deformation and concentration of the soil create a cylindrical cavity with the help of the unrolling mechanism. This device consists of several conical members that rotate freely on the axle. The member axis is shifted by an angle and moves compared to the device axis so that the member moves in a spiral. During rotation and axial movement of the device, the members form a hole in the ground. Each member enters a hole formed from the previous article and thus increases the hole diameter. The soil accumulates in the radial direction, and around the hole it forms a dense zone whose diameter corresponds to 3-4 diameters of the hole.

The formation of the hole with this device corresponds to the surface compaction of the earth, whereby each subsequent article is heavier than the previous one. Unlike traditional methods of forming holes in which the excavated earth is brought to the surface, the proposed device compacts the earth into the walls of the holes. In that way, it enables the formation of a stable cylindrical hole in

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which communications of different purposes can be placed. There are 3 principal parts of machine for rolling holes (Fig. 1):

1. power unit (oil tank);
2. drilling unit with remote control;
3. working body (raskatchik soil).

Advantages machine for rolling holes:

- a. lack of vibration and noiselessness of a driving of holes;
- b. the possibility of the formation of large diameter holes (up to 1 m) and a length of up to 50 m;
- c. the high speed of a driving (10 ... 20m/hour).

Figure 1: Machine for rolling holes.

Figure 2: Creation of holes by the rolling device

Figure 3: Renewal of pipelines with use of the rolling device.

The machine can operate in crowded urban conditions to form holes without removing the soil. Closed pipelines, cables, replacement of old pipes (Figure 2-3) - this is a list of major works carried out using raskatchik.

4. CONCLUSION

Conducted in a production environment testing machine for rolling holes show its performance and identified a number of advantages compared with other similar machines, namely:

1. Environmental safety, quietness, lack of harmful effects on the dynamic service staff and the environment;
2. Higher productivity due to the fact that during the formation of the holes is no extraction of soil outwards and reduced cycle time;
3. Significant economic effect due to the low energy consumption of the process rolling and labor.

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