LITERATURA:

- Eduard Slunjski, STROJEVI U GRAĐEVINARSTVU, HDGI, 1995.
- Gorazd Bučar, NORMATIVI I CIJENE U GRADITELJSTVU, Sveučilište u Rijeci, 2001.

nastavni materijali - predavanja : prof dr.sc. Snježana Knezić

STROJEVI ZA NABIJANJE

U odnosu na način djelovanja razlikujemo tri podskupine:

- strojevi koji nabijaju statički (ježevi, čelični glatki valjci, valjci na gumama)
- strojevi koji nabijaju dinamički koristeći silu slobodnog pada (mehanički i eksplozivni nabijači)
- strojevi koji nabijaju dinamički pomoću vibracija (vibrovaljci, vibroježevi, vibroploče, kompaktori)

JEŽEVI

Koriste se za nabijanje nasipnog materijala.

- visina bodlje iznosi 18 do 23 cm
- na četvorni metar dolazi 10 do 12 bodlji

Duo-Pact 1400
#743

- debljina sloja 1,2 visine bodlje ježa
- prosječni broj prelazaka 10 do 12 puta

- 20 do 60 kN srednje teški
- teži od 60 kN teški

- brzina kretanja 4 -5 km/h
- sila pritiska bodlja ježa iznosi 150 - 400 N/cm^2

Bomag BW213PDB-2
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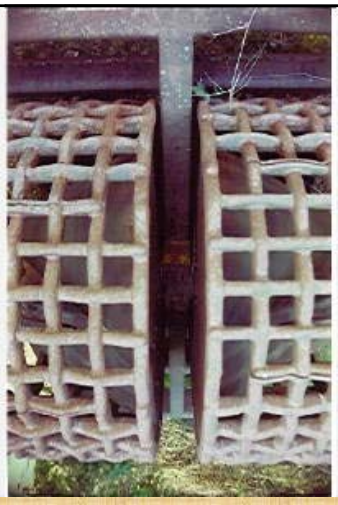


jež - rešetka

jež za kruti otpad

jež za kruti otpad

vučni
jež rešetka

sanduk s
opterećenjem

Planski učinak:

$U_p = (v\ d\ b\ /\ n\ )\ K_v$ (m^3/h)

v - brzina kretanja traktora koji vuče ježeve (m/h)
d - debiljina nasutog sloja poslije nabijanja (m)
b - korisnja širuna ježa (odbiviši preklapanja) (m)
n - broj prijelaza ježa po jednom traku

VALJCI

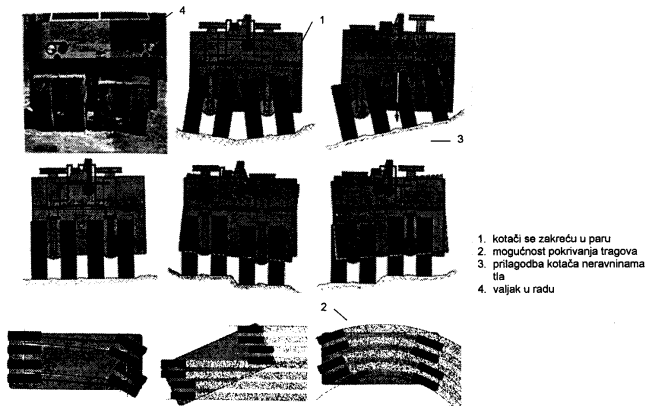
- glatki čelični kotači
- na kotačima s gumama

Prvi parni valjci Aveling and Porter su korišteni
od 1867. Parni pogon se dzadržao duko u 20 stoljeću.

Parni valjak iz 1928.

- za nabijanje 10 do max. 20 cm debljine

- mali i srednje teški do 6t
- srednje veliki I teški 6 - 12 t
- veliki I vrlo teški više od 12 t



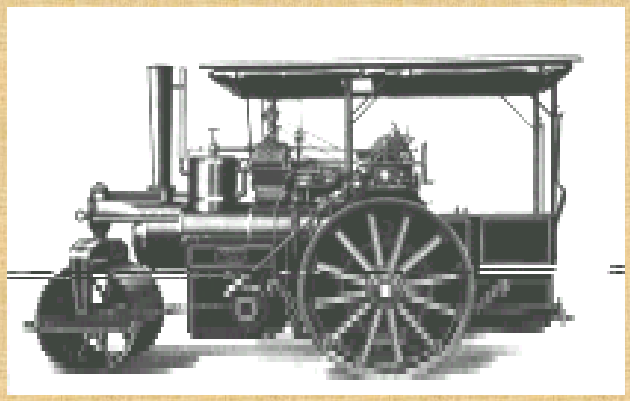
Prilagodba kotača u valjka s 2 · 2 kotača **(Slunjski, 1995.)**

Planski učinak:

$U_p = (v\ d\ b / n)\ K_v$ (m^3/h)

v - brzina kretanja traktora koji vuče ježeve (m/h)
d - debiljina nasutog sloja poslije nabijanja (m)
b - korisnja širuna ježa (odbiviši preklapanja) (m)
n - broj prijelaza ježa po jednom traku

VIBROVALJCI I VIBROJEŽEVI

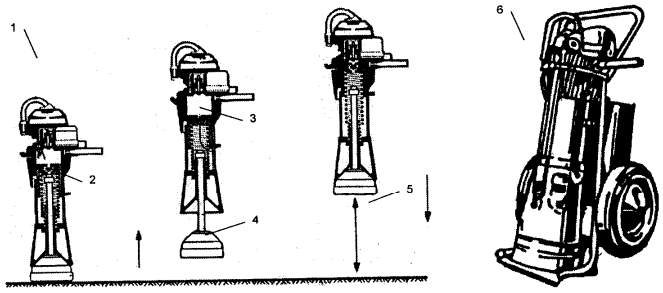



7578
JARVIE PLANT

NABIJAČI

VRSTE:

- mehanički nabijači
- eksplozivni nabijači
- vibronabijači



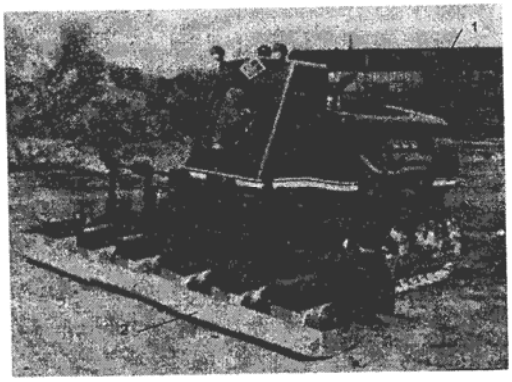
Eksplozivni nabijač

(Slunjski, 1995.)

1. faze rada:
2. prva faza, paljenje eksplozivne smjese
3. druga faza, dizanje gornjeg dijela nabijača,
4. povlačenje donjeg dijela nabijača i usisavanje eksplozivne smjese
5. treća faza, slobodno padanje i nabijanje
6. kolica za prijevoz nabijača

VIBROPLOČE

KOMPAKTORI



1. traktor gusjeničar
2. čelične vibroploče s vibratorima

(Slunjski, 1995.)

Kompaktor

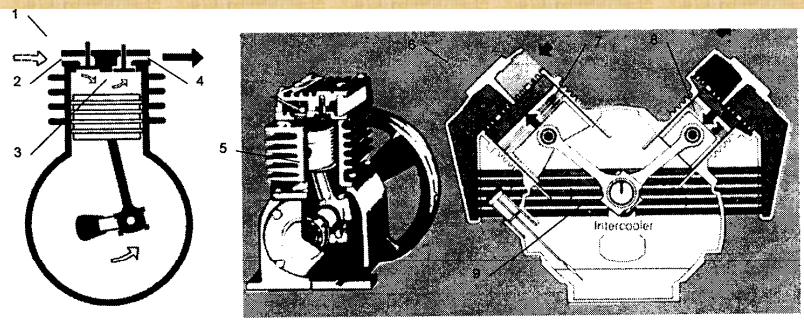
STROJEVI ZA ISKOPE U KAMENU

SKUPINE:

- kompersori za proizvodnju stlačenog zaraka
- alati za razbijanje kamena i bušenje rupa u kamenu
- samopokretne bušilice
- straojevi za taljenje stijene

KOMPRESORI

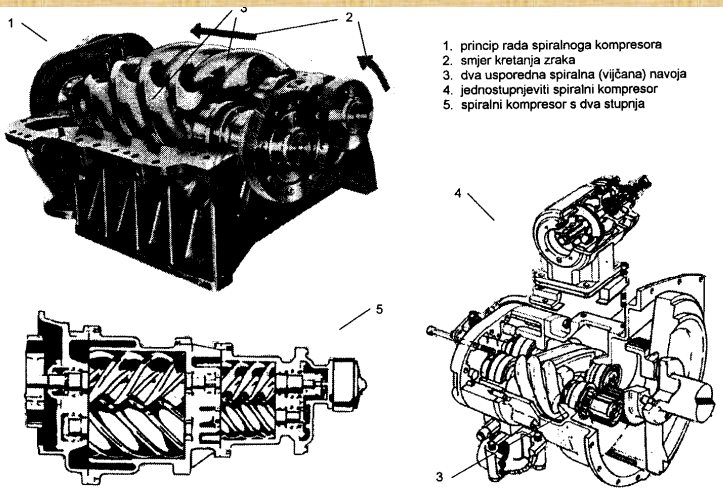
<u>Pokretni na kotačima s gumama</u> - do 8m^3 stlačenog zraka u minuti
<u>Stabilni</u> - više od 8m^3 stlačenog zraka u minuti



1. princip rada stapnoga kompresora
2. usisavanje zraka
3. tlačenje zraka
4. izlaz stlačenog zraka
5. jednostupnjeviti kompresor
6. dvostupnjeviti kompresor
7. tlačenje do 400 kPa
8. tlačenje od 400 do 700 kPa
9. kanali za prolazak polustlačenog zraka

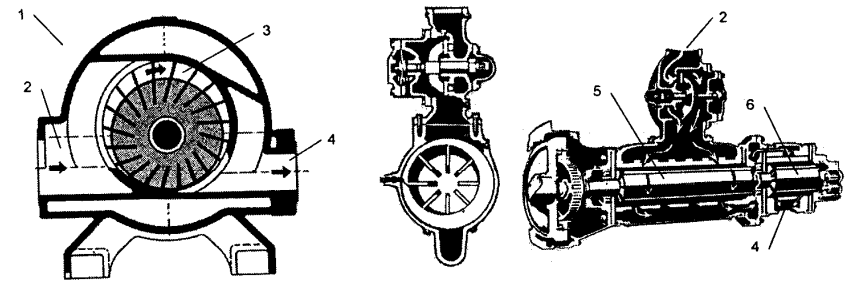
Stapni kompresori

(Slunjski, 1995.)



1. princip rada spiralnoga kompresora
2. smjer kretanja zraka
3. dva usporedna spiralna (vijčana) navoja
4. jednostupnjeviti spiralni kompresor
5. spiralni kompresor s dva stupnja

Spiralni (vijčani) kompresori **(Slunjski, 1995.)**



Rotacijski kompresori

(Slunjski, 1995.)

1. princip rada rotacijskoga kompresora
2. ulazak zraka
3. stlačivanje zraka
4. izlazak stlačenog zraka
5. prvi stupanj tlačenja
6. drugi stupanj tlačenja

ALATI ZA BUŠENJE I RAZBIJANJE

Podjela s obzirom na princip rada:

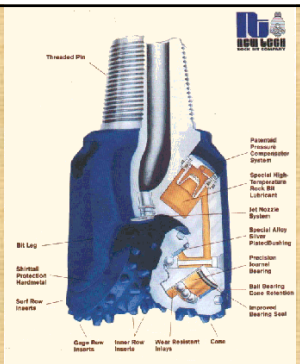
- pokretani stlačenim zrakom
- pokretani hidrauličnim uljem
- s izravnim pogonom, najčešće električnim

1. tijeko čekića s ručnim držačem
2. dovod stlačenog zraka
3. držač šipke za bušenje
4. jednostavno sječivo
5. šupljina za dovod zraka
6. križno sječivo
7. zvjezdasto sječivo
8. zeta sječivo
9. šipka za razbijanje
10. zračni čekić pri radu
11. kompresor pri radu
12. dovodna cijev za stlačeni zrak
13. razbijanje betona

Zračni čekić sa šipkom za bušenje i razbijanje **(Slunjski, 1995.)**

Hidraulički čekić - razbijač

Samopokretne bušilice



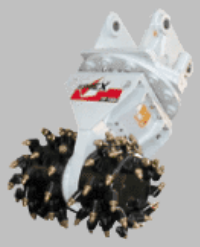
kopači stijenske mase

DOUBLE BRUM

ROTARY CUTTER FOR EXCAVATOR MOUNTING

- Ideal for executing canalizations on hard and compact materials, concrete or rock wall profiling, quarry stopping, demolitions and dredging.
- Indispensable in case of excessive weakness of excavation systems and little effectiveness of percussion systems.
- HIGH PERFORMANCE hydraulic piston motor with big swept volume ensuring LOW SPEED/HIGH TORQUE.
- Minimum non-operative space (120 mm) in the central area between the drums.
- Planing rotation, with hydraulic locking every 30°, for an easy orientation of rotation axis in all operation conditions (optional).
- SUITABLE FOR BACKHOE MOUNTING.

	TF 1000	
Base drums		
Width	1000	mm
Larghezza a richiesta	800	mm
Hydraulic motor power	66 (90)	kw (cv)
Planing RPM	80-110	RPM
Required oil flow	140-220	L.P.M.
Required oil pressure	320-220	BAR
Operative weigth	1280	kg
Excavator weigth	18-25	ton



kopači stijenske mase

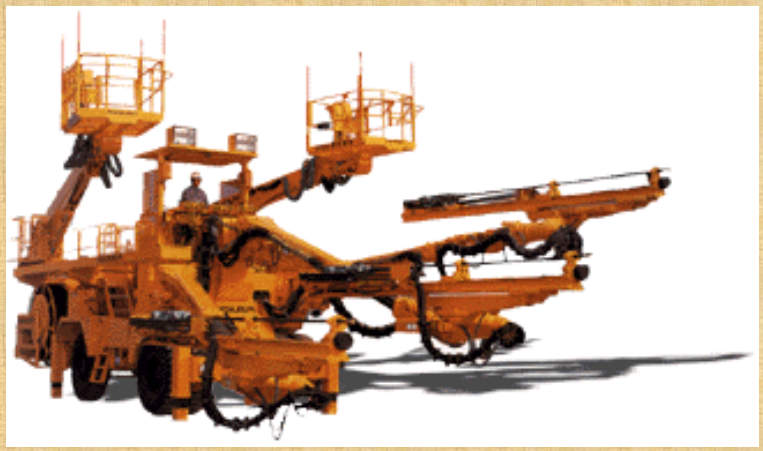
kopači stijenske mase

STROJEVI ZA ISKOP U TUNELIMA

JUMBO

SAMOPOKRETNA BUŠEĆA KOLA

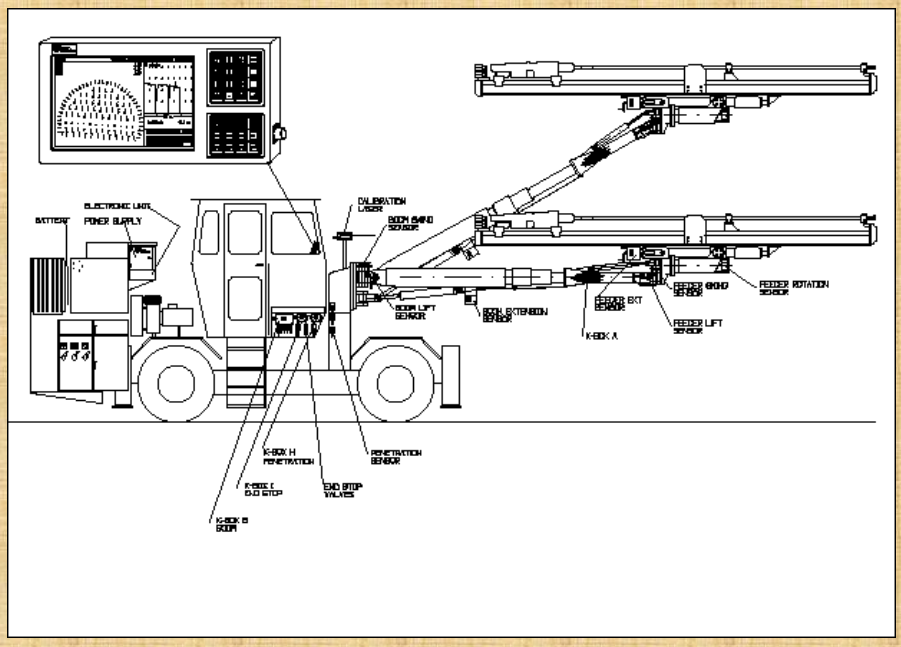
The first seven-arm drilling jumbo




AMV

The main components are angle measuring devices installed in many of the boom joints, linear measuring devices for the boom telescope and feed crowd actions as well as sensors for the measurement of the hole depth and penetration rates. An inclination measuring device is also installed to measure the cross-slope of the jumbo in the drilling position. The placement of the various components on the jumbo is shown on the attached drawing.

Signals from the various sensors are transmitted to the on-board computer where they are transformed to readable data. Some of the data are shown on the computer screen. The screen is the operators main tool for communications with the jumbo.



KRTICA

2 ROBBINS model 167
Hard rock tunnel boring machines

The Project **Lesotho Highlands Water Project**. includes:

- A transfer tunnel, 44.5 km long, of 5.02 m diameter bored through basalt formation.
- A Delivery Tunnel, 12.8 km long of the same diameter bored through sandstone formation, partially concrete lined with two river under-crossing drilled and blast and being steel lined. Six permanent Adits, associated to the tunnels.

The Katse Intake, a reinforced Tower of 94 m high. The MUELA Hydropower civil works, including access tunnel, underground power house, tailrace tunnel, surge shaîts.

· The MUELA Dam, a double curvature concrete Dam.
· Technical Operating Building and Workshop.
· Access Road
- Two permanent Camps.

Estimated quantities:

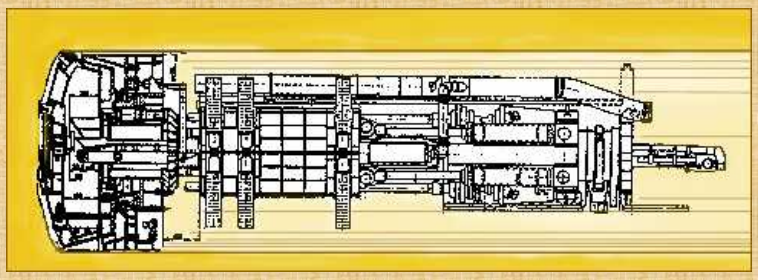
- Volume Rock Excavation 260,000 m3
- Underground Rock Excavation 1,540,000 m3
- Concrete tunnel + Dam + Power Station 400,000 m3
- Total TBM drives length 58.4 km
- Total D & B Adit length 7.5 km

- 31 Cutters of 432mm (17") Diameter
- Checking and change of Cutters from the back side of the Cutterhead
- Specifically designed to deal with hard rock formations
- Capable of boring 5,03 m diameter drive and allows manual rockbolting and reinforcing where necessary
- Hydraulically actuated steering, assisted by use of targets and laser beam

WIRTH TBS III 458/480
Hard rock tunel boring machine

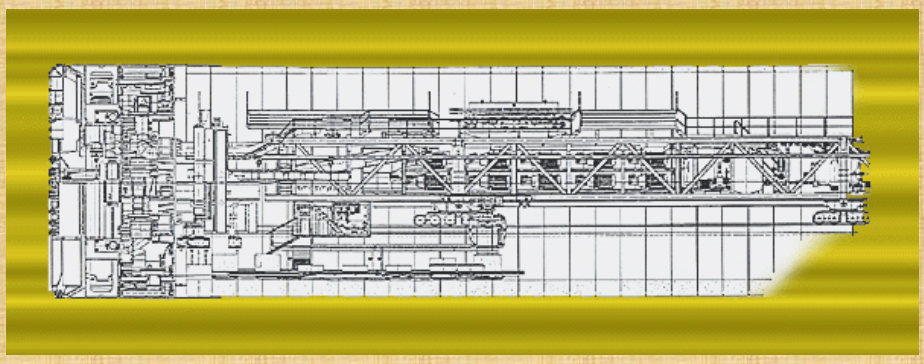
Tunnel boring machine "Hard rock" WIRTH TBS III 458/480, with a 4.58 to 4.8 m diameter.

Design of the machine Hard Rock open type
Year of manufacturing 1985
Power requirement 960 KW
Maximum Thrust 8400 KN
Motorisation variable hydraulic driven cutter head
Disc cutters 16"
Stroke 1500 mm
Voltage 13800 V/380 V
Frequency 50 Hz; Ventilation Fan 3 cum/s
Dust Scrubber 6 cum/s
Auxillary Equipment Beam erector Hydraulic rockbolter

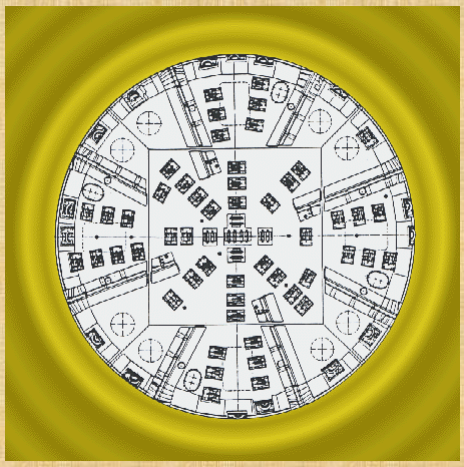


Shielded Hard rock Tbm
Herrenknech S89

One Tunnel boring machine "Hard rock" single shield with a 12.535m diameter



Design of the machine Hard Rock single shield machine
Year of manufacturing 1993
Power requirement 3600 KW
Maximum Thrust 18000 KN
Motorisation variable hydraulic driven cutter head 0-4.3RPM
Disc cutters 77*17"; Stroke 1800 mm
Voltage 13600 V/380 V; Frequency 50 Hz
Ventilation Fan 115 m3/sec
Dust Scrubber Auxillary Equipment 12 m3 mortier container/injection pomp

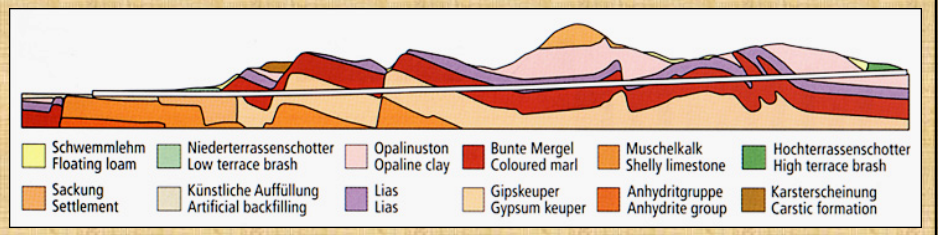


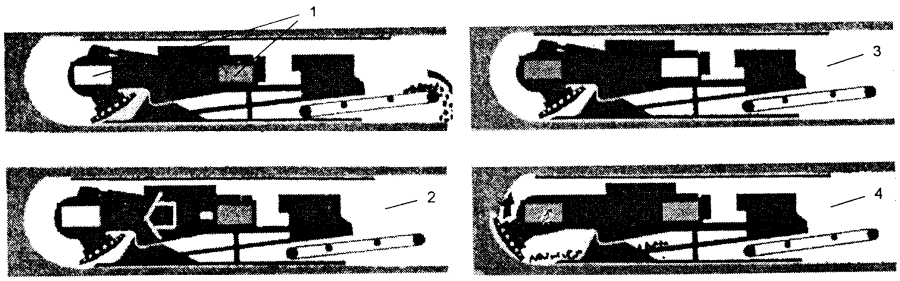
SCOPE OF WORKS AND GEOLOGY:

The works are carried out within the frame of RAIL 2000 (new Swiss railway network).
The total length of the project is 5,745 m and it includes :
- a 4,090 m long railway tunnel, 12.56 m dia, driven using a HERRENKNECHT TBM,
- a 980 m long cut and cover,
- a 170 m long tunnel excavated using the drill and blast method,
- a 505 m long open trench.

Tunnel supporting by segments.
Concrete lining.
PVC waterproofing.

Geology : lias, clay, sandstone with gypsum.





1. otpušteni prvi bočni oslonci, a uprti zadnji
2. pomicanje prvog dijela naprijed
3. uprti prvi bočni oslonci, otpušteni zadnji, pomicanje drugog dijela naprijed
4. uprti prvi i zadnji oslonci, potiskivanje glave i kopanje

Faze rada tunelske krtice za mekane iskope

(Slunjski, 1995.)