



INSTITUT M O L d.o.o.

Privredno društvo za hemiju, biotehnologiju i konsalting
Nikole Tesle br. 15, 22300 Stara Pazova, tel/faks: (022) 2100-325,
(022) 317-652 e-mail: mol@mol.rs http://www.mol.rs



IZVEŠTAJ O ISPITIVANJU BAKARNE ŠLJAKE KAO ABRAZIVNOG MATERIJALA ZA PESKARENJE I NJEGOVIH EKOLOŠKIH KARAKTERISTIKA

Stara Pazova, jun 2016. godine



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 2 od 17

1. OSNOVNI PODACI

Predmet:	Ispitivanje bakarne šljake kao abrazivnog materijala za peskarenje i njegovih ekoloških karakteristika
Podaci o korisniku (naziv, adresa, tel/fax, e-mail):	GRIT COMMERCE d.o.o. Bulevar Mihaila Pupina 115v, Novi Beograd
Podaci sa korisnikovog zahteva/datum:	Zahtev od 12.05.2016. godine
Uzorkovanje izvršio/datum:	Korisnik
Plan i procedure uzorkovanja:	-
Datum prijema uzoraka:	12.05.2016. godine
Opis, vrsta, broj i identifikacija uzoraka:	6 (šest) uzoraka, l.b. 1284,1285,1288,1289,1290 i 1293
Metode određivanja:	Dati su u tabeli sa rezultatima
Rezultati ispitivanja:	Dati su u tabelama
Tim koji je realizovao Ispitivanja/funkcija:	Vladimir Dražić, dipl. hem./analitičar Dejan Savić, dipl. ing. tehn./analitičar dr Slavko Čušić, spec. toksikološke hemije/analitičar Igor Urošević, dipl. hem./analitičar Snežana Arsić/tehničar
Obrada podataka i izrada izveštaja:	Jelena Petrović, dipl. hem./analitičar za obradu podataka

Rezultati dati u ovom izveštaju se odnose samo na ispitani uzorak; ne preuzima se odgovornost u pogledu verodostojnosti uzorka, osim u slučaju da je ono obavljeno pod kontrolom predstavnika MOL-Laboratorije; ukoliko u roku od 15 dana od dana dostavljanja izveštaja ne dobijemo tehnički prigovor, ispitivanje ćemo smatrati okončanim.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16

Strana: 3 od 17

IZVOD IZ ZAKLJUČKA (STR. 17 OVOG IZVEŠTAJA)

- Sve izmerene fizičke karakteristike ispitivanog materijala, bakarne šljake, pokazuju da je odličan za primenu prilikom peskarenja.
- Prilikom upotrebe ovog materijala ne dolazi do eluiranja štetnih supstanci, te se i sa aspekta uticaja na životnu sredinu može smatrati kao inertan materijal.
- Minerološki sastav materijala i prisutne makrokomponente ga čine bezbednim za primenu po kvalitet životne sredine.
- Materijal je klasifikovan kao **NEOPASAN** i posle upotrebe se može deponovati na deponiju neopasnog otpada po važećoj zakonskoj regulativi.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 4 od 17

2. PREDMET I CILJ ISPITIVANJA

Predmet ispitivanja je bakarna šljaka granulacije 0.5-1.68 mm i 1.68 -3.00 mm.

Cilj ispitivanje je utvrđivanje primenjivosti ovog materijala kao abraziva za peskarenje i njegovih ekoloških karakteristika.

3. PRIMENSKA ISPITIVANJA

Primenska ispitivanja peskarenja su vršena na korodiranom čeličnom limu debljine 8 mm i to sa originalnom frakcijom i višestrukom upotrebom na radnom pritisku od 6 bara.

KORIŠTENA OPREMA:

Kompresor Atlas Copco XAS 186

Peskara MAXIV TECH DBS 200 (SGV ventil)

Keramička dizna precnoka 8 mm

Tehničke mogućnosti peskarenja 15 m² /h

3.1. GRANULACIJA 0.5-1.68 mm

Rezultati prve upotrebe

Srednja aritmetička vrednost hrapavosti	Ra = 100
Potrošnja grita	32 kg/ m ²

Rezultati druge upotrebe

Srednja aritmetička vrednost hrapavosti	Ra = 100
Potrošnja grita	33 kg/ m ²

Rezultati treće upotrebe

Srednja aritmetička vrednost hrapavosti	Ra = 80
Potrošnja grita	38 kg/ m ²

Rezultati četvrte upotrebe

Srednja aritmetička vrednost hrapavosti	Ra = 50
Potrošnja grita	42 kg/ m ²



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 5 od 17

3.2. GRANULACIJA 1.68-3.00 mm

Rezultati prve upotrebe

Srednja aritmetička vrednost hrapavosti	$R_a = 100$
Potrošnja grita	30 kg/m^2

Rezultati druge upotrebe

Srednja aritmetička vrednost hrapavosti	$R_a = 100$
Potrošnja grita	30 kg/m^2

Rezultati treće upotrebe

Srednja aritmetička vrednost hrapavosti	$R_a = 100$
Potrošnja grita	33 kg/m^2

Rezultati četvrte upotrebe

Srednja aritmetička vrednost hrapavosti	$R_a = 80$
Potrošnja grita	36 kg/m^2



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 6 od 17

4. HEMIJSKA ISPITIVANJA

4.1. REZULTATI ISPITIVANJA ISPITIVANJE ČVRSTIH UZORAKA I NJIHOVIH ELUATA

4.1.1. Granulacija 0.5-1.68 mm

Ispitivanje je vršeno sa ciljem ustanovljavanja mikro i makrokomponenti, kako zbog korisnih jonskih vrsta, tako i zbog negativnog uticaja na kvalitet životne sredine.

Tabela 1. Rezultati fizičko-hemijskih ispitivanja dostavljenog uzorka lab.broj 1284, frakcija 0.5-1.68 mm, **originalni uzorak bakarne šljake**

Parametar	Metoda	Merna jedinica	Nadena vrednost
Olovo (Pb)	VM 030-1	mg/kg	124.64
Kadmijum (Cd)	VM 042-1	mg/kg	0.40
Cink (Zn)	VM 035-1	%	0.16
Bakar (Cu)	VM 032-1	%	0.39
Hrom ukupni, (Cr)	VM 037-1	mg/kg	21.94
Nikl (Ni)	VM 033-1	mg/kg	7.37
Arsen (As)	VM 043-1	mg/kg	25.92
Vanadijum (V)	VM 059-1	mg/kg	23.63
Mangan (Mn)	VM 036-1	mg/kg	104.69
Gvožđe (Fe)	VM 038-1	%	8.75

Napomena: Rezultati su dati u odnosu na masu suvog uzorka

KOMENTAR: važno je napomenuti da je koncentracija bakra u ovom uzorku značajna. Sigurno treba razmišljati o hidrometalurškom postupku za potencijalno dobijanje bakra, a sve u zavisnosti količine materijala. U uzorku nije detektovana koncentracija jona koja bi ga karakterisala kao opasan materijal.

Nakon ispitivanja čvrste faze pristupilo se ispitivanju eluata. Eluiranje je vršeno na mućkalici, 24 sata kontinualno, sa 40 rpm, u bocama od 1 L. Odnos čvrste i tečne faze je bio 1: 20. Isti tretman je primenjivan na obe granulacije šljake.

U eluatu su određivane jonske vrste. Nadjene koncentracije su navedene u Tabeli 2.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 7 od 17

Tabela 2. Rezultati fizičko-hemijskih ispitivanja eluata uzorka lab.broj 1284, frakcija 0.5-1.68 mm, originalni uzorak bakarne šljake

Parametar	Metoda	Merna jedinica	Rezultat ispitivanja
Sadržaj u EP ekstraktu nakon 24h (jednostepeni test, odnos tečno/čvrsto = 10l/kg) SRPS EN 12457-4			
pH vrednost	SRPS H.Z1.111:1987	-	7.66
Elektrolitička provodljivost	ASTM D 1125A-95:2009	μS/cm	110
Olovo (Pb)	EPA M 239.2:1978	mg/kg	<0.03
Kadmijum (Cd)	EPA M 213.2:1978	mg/kg	<0.003
Cink (Zn)	EPA M 289.1:1978	mg/kg	<0.16
Bakar (Cu)	EPA M 220.1:1978	mg/kg	<0.60
Hrom ukupni (Cr)	EPA M 218.2:1978	mg/kg	<0.03
Nikl (Ni)	EPA M 249.1:1978	mg/kg	<0.03
Arsen (As)	EPA M 206.2:1978	mg/kg	<0.03

KOMENTAR: nije nadjena povećana koncentracija jonskih vrsta, niti povećana provodljivost. Ovo pokazuje da je materijal potpuno bezbedan za primenu.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 8 od 17

Ispitivanja nakon upotrebe, odnosno tretmana površine, ukazuju na potencijalne strukturne promene u materijala. Ove strukturne promene mogu dovesti do veće kontaktne površine i do povećane elucije jonskih vrsta. Zato se pristupilo i karakterizaciji posle prvog i posle četvrtog "prelaza" istog materijala.

Tabela 3. Rezultati fizičko-hemijskih ispitivanja dostavljenog uzorka lab.broj 1285, frakcija 0.5-1.68 mm, "prvi prelaz"

Parametar	Metoda	Merna jedinica	Nađena vrednost
Olovo (Pb)	VM 030-1	mg/kg	149.29
Kadmijum (Cd)	VM 042-1	mg/kg	0.48
Cink (Zn)	VM 035-1	%	0.16
Bakar (Cu)	VM 032-1	%	0.36
Hrom ukupni, (Cr)	VM 037-1	mg/kg	22.36
Nikl (Ni)	VM 033-1	mg/kg	7.29
Arsen (As)	VM 043-1	mg/kg	23.43
Vanadijum (V)	VM 059-1	mg/kg	17.89
Mangan (Mn)	VM 036-1	mg/kg	106.78
Cvožđe (Fe)	VM 038-1	%	8.48

Napomena: Rezultati su dati u odnosu na masu suvog uzorka

Tabela 4. Rezultati fizičko-hemijskih ispitivanja eluata lab.broj 1285, frakcija 0.5-1.68 mm, "prvi prelaz"

Parametar	Metoda	Merna jedinica	Rezultat ispitivanja
Sadržaj u EP ekstraktu nakon 24h (jednostepeni test, odnos tečno/cvrsto = 10l/kg) SRPS EN 12457-4			
pH vrednost	SRPS H.Z1.111:1987	-	7.67
Elektrolitička provodljivost	ASTM D 1125A-95:2009	μS/cm	103
Olovo (Pb)	EPA M 239.2:1978	mg/kg	<0.03
Kadmijum (Cd)	EPA M 213.2:1978	mg/kg	<0.003
Cink (Zn)	EPA M 289.1:1978	mg/kg	<0.16
Bakar (Cu)	EPA M 220.1:1978	mg/kg	<0.60
Hrom ukupni (Cr)	EPA M 218.2:1978	mg/kg	<0.03
Nikl (Ni)	EPA M 249.1:1978	mg/kg	<0.03
Arsen (As)	EPA M 206.2:1978	mg/kg	<0.03



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 9 od 17

Tabela 5. Rezultati fizičko-hemijskih ispitivanja dostavljenog uzorka lab.broj 1288, frakcija 0.5-1.68 mm, "četvrti prelaz"

Parametar	Metoda	Merna jedinica	Nadena vrednost
Olovo (Pb)	VM 030-1	mg/kg	154.00
Kadmijum (Cd)	VM 042-1	mg/kg	0.62
Cink (Zn)	VM 035-1	%	0.17
Bakar (Cu)	VM 032-1	%	0.38
Hrom ukupni, (Cr)	VM 037-1	mg/kg	19.44
Nikl (Ni)	VM 033-1	mg/kg	7.23
Arsen (As)	VM 043-1	mg/kg	23.88
Vanadijum (V)	VM 059-1	mg/kg	14.62
Mangan (Mn)	VM 036-1	mg/kg	108.11
Gvožđe (Fe)	VM 038-1	%	8.15

Napomena: Rezultati su dati u odnosu na masu suvog uzorka

Tabela 6. Rezultati fizičko-hemijskih ispitivanja eluata uzorka lab.broj 1288, frakcija 0.5-1.68 mm, "četvrti prelaz"

Parametar	Metoda	Merna jedinica	Rezultat ispitivanja
Sadržaj u EP ekstraktu nakon 24h (jednostepeni test, odnos tečno/čvrsto = 10l/kg) SRPS EN 12457-4			
pH vrednost	SRPS H.Z1.111:1987	-	7.47
Elektrolitička provodljivost	ASTM D 1125A-95:2009	μS/cm	111
Olovo (Pb)	EPA M 239.2:1978	mg/kg	<0.03
Kadmijum (Cd)	EPA M 213.2:1978	mg/kg	<0.003
Cink (Zn)	EPA M 289.1:1978	mg/kg	<0.16
Bakar (Cu)	EPA M 220.1:1978	mg/kg	<0.60
Hrom ukupni (Cr)	EPA M 218.2:1978	mg/kg	<0.03
Nikl (Ni)	EPA M 249.1:1978	mg/kg	<0.03
Arsen (As)	EPA M 206.2:1978	mg/kg	<0.03

KOMENTAR: sadržaj jonskih vrsta u čvrstom uzorku, odnosno njegovom eluata nakon prvog i četvrtog prolaza se praktično nije promenio. Ovo je pokazatelj da, što se tiče hemijskih i eko- hemijskih karakteristika četiri "prelaza", odnosno četiri ciklusa upotrebe istog materijala je minimalan broj upotrebe. Napominjemo da je koncentracija bakra i u četvrtom prelazu značajna, što upućuje na mogućnost korišćenja.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 10 od 17

4.1.2. Granulacija 1,68-3,00 mm

Tabela 7. Rezultati fizičko-hemijskih ispitivanja dostavljenog uzorka lab.broj 1289, frakcija 1.68-3.00 mm, **originalni uzorak bakarne šljake**

Parametar	Metoda	Merna jedinica	Nadena vrednost
Olovo (Pb)	VM 030-1	mg/kg	76.18
Kadmijum (Cd)	VM 042-1	mg/kg	0.08
Cink (Zn)	VM 035-1	%	0.07
Bakar (Cu)	VM 032-1	%	0.21
Hrom ukupni, (Cr)	VM 037-1	mg/kg	8.60
Nikl (Ni)	VM 033-1	mg/kg	<6.00
Arsen (As)	VM 043-1	mg/kg	12.20
Vanadijum (V)	VM 059-1	mg/kg	9.20
Mangan (Mn)	VM 036-1	mg/kg	45.74
Gvožđe (Fe)	VM 038-1	%	3.90

Napomena: Rezultati su dati u odnosu na masu suvog uzorka

KOMENTAR: U ovom slučaju je koncentracija bakra niža nego u predhodnoj sitnijoj frakciji, što je razumljivo, ipak i u ovom uzorku koncentracija bakra je značajna. Sigurno treba razmišljati o hidrometalurškom postupku za potencijalno dobijanje bakra, a sve u zavisnosti količine materijala. U uzorku nije detektovana koncentracija jona koja bi ga karakterisala kao opasan materijal.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 11 od 17

Tabela 8. Rezultati fizičko-hemijskih ispitivanja eluata uzorka lab.broj 1289, frakcija 1.68-3.00 mm, originalni uzorak bakarne šljake

Parametar	Metoda	Merna jedinica	Rezultat ispitivanja
Sadržaj u EP ekstraktu nakon 24h (jednostepeni test, odnos tečno/čvrsto = 10l/kg) SRPS EN 12457-4			
pH vrednost	SRPS H.Z1.111:1987	-	7.30
Elektrolitička provodljivost	ASTM D 1125A-95:2009	μS/cm	60
Olovo (Pb)	EPA M 239.2:1978	mg/kg	<0.03
Kadmijum (Cd)	EPA M 213.2:1978	mg/kg	<0.003
Cink (Zn)	EPA M 289.1:1978	mg/kg	<0.16
Bakar (Cu)	EPA M 220.1:1978	mg/kg	<0.60
Hrom ukupni (Cr)	EPA M 218.2:1978	mg/kg	<0.03
Nikl (Ni)	EPA M 249.1:1978	mg/kg	<0.03
Arsen (As)	EPA M 206.2:1978	mg/kg	<0.03

KOMENTAR: nije nadjena povećana koncentracija jonskih vrsta, niti povećana provodljivost. Ovo pokazuje da je materijal potpuno bezbedan za primenu.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 12 od 17

Tabela 9. Rezultati fizičko-hemijskih ispitivanja dostavljenog uzorka lab.broj 1290, frakcija 1.68-3.00 mm, "prvi prelaz"

Parametar	Metoda	Merna jedinica	Nadena vrednost
Olovo (Pb)	VM 030-1	mg/kg	56.13
Kadmijum (Cd)	VM 042-1	mg/kg	<0.016
Cink (Zn)	VM 035-1	%	0.05
Bakar (Cu)	VM 032-1	%	0.13
Hrom ukupni, (Cr)	VM 037-1	mg/kg	<8.00
Nikl (Ni)	VM 033-1	mg/kg	<6.00
Arsen (As)	VM 043-1	mg/kg	7.82
Vanadijum (V)	VM 059-1	mg/kg	4.44
Mangan (Mn)	VM 036-1	mg/kg	34.20
Gvožđe (Fe)	VM 038-1	%	3.10

Napomena: Rezultati su dati u odnosu na masu suvog uzorka

Tabela 10. Rezultati fizičko-hemijskih ispitivanja eluata uzorka lab.broj 1290, frakcija 1.68-3.00 mm, "prvi prelaz"

Parametar	Metoda	Merna jedinica	Rezultat ispitivanja
Sadržaj u EP ekstraktu nakon 24h (jednostepeni test, odnos tečno/čvrsto = 10l/kg) SRPS EN 12457-4			
pH vrednost	SRPS H.Z1.111:1987	-	7.85
Elektrolitička provodljivost	ASTM D 1125A-95:2009	μS/cm	64
Olovo (Pb)	EPA M 239.2:1978	mg/kg	<0.03
Kadmijum (Cd)	EPA M 213.2:1978	mg/kg	<0.003
Cink (Zn)	EPA M 289.1:1978	mg/kg	<0.16
Bakar (Cu)	EPA M 220.1:1978	mg/kg	<0.60
Hrom ukupni (Cr)	EPA M 218.2:1978	mg/kg	<0.03
Nikl (Ni)	EPA M 249.1:1978	mg/kg	<0.03
Arsen (As)	EPA M 206.2:1978	mg/kg	<0.03



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 13 od 17

Tabela 11. Rezultati fizičko-hemijskih ispitivanja dostavljenog uzorka lab.broj 1293, frakcija 1.68-3.00 mm, "četvrti prelaz"

Parametar	Metoda	Merna jedinica	Nađena vrednost
Olovo (Pb)	VM 030-1	mg/kg	73.23
Kadmijum (Cd)	VM 042-1	mg/kg	<0.016
Cink (Zn)	VM 035-1	%	0.07
Bakar (Cu)	VM 032-1	%	0.18
Hrom ukupni, (Cr)	VM 037-1	mg/kg	<8.00
Nikl (Ni)	VM 033-1	mg/kg	<6.00
Arsen (As)	VM 043-1	mg/kg	9.14
Vanadijum (V)	VM 059-1	mg/kg	4.82
Mangan (Mn)	VM 036-1	mg/kg	43.56
Gvožđe (Fe)	VM 038-1	%	3.46

Napomena: Rezultati su dati u odnosu na masu suvog uzorka

Tabela 12. Rezultati fizičko-hemijskih ispitivanja eluata uzorka lab.broj 1293, frakcija 1.68-3.00 mm, "četvrti prelaz"

Parametar	Metoda	Merna jedinica	Rezultat ispitivanja
Sadržaj u EP ekstraktu nakon 24h (jednostepeni test, odnos tečno/čvrsto = 10l/kg) SRPS EN 12457-4			
pH vrednost	SRPS H.Z1.111:1987	-	7.54
Elektrolitička provodljivost	ASTM D 1125A-95:2009	μS/cm	81
Olovo (Pb)	EPA M 239.2:1978	mg/kg	<0.03
Kadmijum (Cd)	EPA M 213.2:1978	mg/kg	<0.003
Cink (Zn)	EPA M 289.1:1978	mg/kg	<0.16
Bakar (Cu)	EPA M 220.1:1978	mg/kg	<0.60
Hrom ukupni (Cr)	EPA M 218.2:1978	mg/kg	<0.03
Nikl (Ni)	EPA M 249.1:1978	mg/kg	<0.03
Arsen (As)	EPA M 206.2:1978	mg/kg	<0.03

KOMENTAR: sadržaj jonskih vrsta u čvrstom uzorku, odnosno njegovom eluatu nakon "prvog" i "četvrtog prelaza" se praktično nije promenio. Ovo je pokazatelj da, što se tiče hemijskih i eko- hemijskih karakteristika četiri "prelaza", odnosno četiri ciklusa upotrebe istog materijala je minimalan broj upotrebe. Napominjemo da je koncentracija bakra i u četvrtom prelazu značajna, mada manja nego u "četvrtom" prelazu sitnije frakcije, što takodje upućuje na mogućnost korišćenja.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 14 od 17

5. GRANULOMETRIJSKA ODREĐIVANJA

Granulometrijska odredjivanja su takodje radjena na istim frakcijama kao i osnovne hemijske analize: originalni materijal, prvi prelaz i četvrti prelaz, naravno za obe frakcije (kako za 0,50-1,68 mm tako i za 1,68-3,00mm). Na ovaj način je utvrđivan »stepen usitnjenosti«. Naime glavna frakcija je dominantna i nakon »četvrtog prolaza«, što pokazuje da je materijal izuzetno primenjiv za peskarenje i to minimum četiri ciklusa sa istim materijalom.

Granulometrijski sastav je dat u Tabelama 13. i 14., a granulometrijske krive u Prilogu ovog izveštaja.

OZNAKA UZORKA	VLAŽNOST SRPS UB1.012- porusen	GRANULOMETRIJSKI SASTAV SRPS UB1.016-porusen									
		Frakcije					d ₅₀	d ₆₀	d ₈₀	C _u	C _z
		Crudina d=60.01 mm	Šljunak d=60.020 mm	Pesak d=2.0-0.063 mm	Pršina d=0.063-0.002 mm	Čina d=0.002 mm					
		W					mm	mm	mm	d ₅₀ /d ₆₀	d ₅₀ /d ₈₀
0.50-1.68	0.06		9	89	2		1.16773	0.66231	0.27348	4.38	1.42
I prelaz	0.06		5	94	1		0.86638	0.48917	0.17273	5.54	1.45
IV prelaz	0.06		4	95	1		0.88444	0.39781	0.14836	5.83	1.23

Tabela 13. Granulometrijska odredjivanja na frakciji bakarne šljake 0,50-1,68mm

OZNAKA UZORKA	VLAŽNOST SRPS UB1.012- porusen	GRANULOMETRIJSKI SASTAV SRPS UB1.016-porusen									
		Frakcije					d ₅₀	d ₆₀	d ₈₀	C _u	C _z
		Crudina d=60.01 mm	Šljunak d=60.020 mm	Pesak d=2.0-0.063 mm	Pršina d=0.063-0.002 mm	Čina d=0.002 mm					
		W					mm	mm	mm	d ₅₀ /d ₆₀	d ₅₀ /d ₈₀
1.68-3.00	0.06		35	84	1		1.92474	1.47931	1.18236	1.63	0.96
I prelaz	0.06		25	75			1.74858	1.25616	0.62041	2.82	1.48
IV prelaz	0.06		23	78	1		1.68508	1.14327	0.43326	3.88	1.79

Tabela 14. Granulometrijska odredjivanja na frakciji bakarne šljake 1,68-3,00mm

NAPOMENA: Odredjivana granulometrija i naziv frakcije uzoraka se razlikuju u prihvatljivoj meri tako da je u ovom izveštaju zadržan tehnički naziv donetih originalnih uzoraka.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 15 od 17

6. OTPORNOST NA DROBLJENJE

6.1 Otpornost na drobljenje - metoda Degremont

Otpornost na drobljenje je vršen sa ciljem potvrde materijala pogodnim za peskarenje. Iako su zaključci dati prilikom granulometrijskih odredjivanja originalnog uzorka i njegovih ciklusa, metoda ove vrste upućuje na agzaktne pokazatelje.

OPIS: na osnovu rezultata prosejavanja pre i posle ispitivanja uradeni su dijagrami iz kojih je izračunata drobljivost. Ispitivanje drobljivosti je izvršeno sa 18 čelčnih kugli promera 12 mm, nakon 30 minuta, odnosno 1500 obrtaja.

Oprema za ispitivanje

- Sušnica - "Instrumentaria" Hrvatska
- Elektronska vaga sa opsegom merenja do 10 kg - "Tuf Co." Srbija
Merna nesigurnost $U(R)=4.082483$ g
Nivo poverenja je bolji od 95 %
- Set sita
- Laboratorijske posude i prateći pribor
- Deval mašina

6.2 Rezultati ispitivanja

6.2.1. Bakarna šljaka, granulacija 0,5-1,68 mm

Prvo merenje

Drobljivost: 10 %

Drugo merenje

Drobljivost: 8,9%

Srednja vrednost merenja: 9,45 %

Ocena: domen uobičajene upotrebe: **veoma dobar**



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 16 od 17

6.2.2. Bakarna šljaka, granulacija 1,68-3,00 mm

Prvo merenje

Drobljivost: 8,9 %

Drugo merenje

Drobljivost: 7,8%

Srednja vrednost merenja: 8,35 %

Ocena: domen uobičajene upotrebe: **veoma dobar**

KOMENTAR:

Ovi rezultati su slični rezultatima koji se dobijaju prilikom ispitivanja kvarcnog peska. Znači da je primenska vrednost materijala slična kvarcnom pesku!

Pomenuta metoda daje određene klasifikacije, klasa materijala 15-20% gubitka dominantne granulometrijske frakcije se smatra „veoma dobrom“. U našem slučaju drobljivost u svim ispitivanim uzorcima je praktično manja od 10 %.

Metoda nema odredbe za manje gubitke od navedenih, što ponovo potvrđuje upotrebljivost materijala za peskarenje.

7. NAKNADNA ISPITIVANJA

Naknadna ispitivanja su u originalu data u Prilogu ovog izveštaja i obuhvataju određivanje tvrdoće, mineralogkog sastava, kao i u manjoj meri sastav eluata i osnovne komponente čvrstog uzorka na reprezentativnim količinama kao i radioaktivnosti. Određivanje tvrdoće po Moss- ovoj skali takodje pokazuje veoma veliku sličnost sa kvarcom. Sva naknadna ispitivanja potvrđuju vrednost materijala i ekološku neškodljivost.

Takodje naknadnim ispitivanjima je vršena karakterizacija materijala kao otpada. Izveštaj o karakterizaciji je u celosti dat u Prilogu.

Otpad je okarakterisan kao NEOPASAN.



IZVEŠTAJ O ISPITIVANJU



Izveštaj: I 324/16
Strana: 17 od 17

8. ZAKLJUČAK

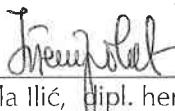
Navedene metode ispitivanja pokazuju upotrebljivost i neškodljivost materijala bakarne šljake kao medijuma za peskarenje. Izveštaji renomiranih kuća u prilogu ovog izveštaja potvrđuju navedene komentare. Sva sprovedena ispitivanja se mogu sumirati u nekoliko tačaka:

1. Sve izmerene fizičke karakteristike materijala pokazuju da je odličan za primenu prilikom peskarenja
2. Minimalan broj ciklusa upotrebe materijala je četiri. Prilikom četiri ciklusa peskarenja, materijal zadržava osnovne fizičke karakteristike, te se ne umanjuje njegova efikasnost.
3. Prilikom upotrebe materijala ne dolazi do eluiranja štetnih supstanci, te se i sa aspekta uticaja na životnu sredinu može smatrati kao inertan materijal
4. Minerološki sastav materijala i prisutne makrokomponente ga čine bezbednim za primenu po kvalitet životne sredine.
5. Materijal je klasifikovan kao NEOPASAN i posle upotrebe se može deponovati na deponiju neopasnog otpada po važećoj zakonskoj regulativi.

Mesto i datum završetka ispitivanja:
Stara Pazova, 02.06.2016. godine

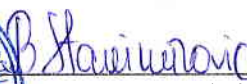
Datum predaje Izveštaja:
02.06.2016. godine

Izveštaj verifikovao:
Rukovodilac laboratorije


/Danijela Ilić, dipl. hem./

Izveštaj odobrio:
Direktor




/mr. Bojana Stanimirović, dipl. biohem./

PRILOZI UZ IZVEŠTAJ

PRIOLOG 1.


Акредитационо тело Србије
Accreditation Body of Serbia
Београд
Belgrade
додељује
awards

00557


СЕРТИФИКАТ О АКРЕДИТАЦИЈИ
Accreditation Certificate
којим се потврђује да
confirming that
ИНСТИТУТ МОЛ Д.О.О.
Привредно друштво за хемiju, биотехнологију и консалтинг
Стира Пазова

акредитациони број
accreditation number
01-172
задовољава захтеве стандарда
fulfils the requirements of
SRPS ISO/IEC 17025:2006
(ISO/IEC 17025:2005)
те је компетентна за обављање послова испитивања
and is competent to perform testing activities
који су специфицирани у обиму акредитације
as specified in the scope of accreditation
Важеће издање обима акредитације доступно је на интернет адреси: www.ats.rs
Valid scope of accreditation can be found at: www.ats.rs

Сертификат додељен
Date of issue
14.04.2015.
Акредитација важи до
Date of expiry
13.04.2019.


Директор
Director
MIL

Акредитационо тело Србије је потписник Мултилатералног споразума о потврђивању обима акредитације системима акредитације. www.ats.rs
Slika 1. Akreditacija Instituta MOL d.o.o.

NAPOMENA: Obim akreditacije je naveden na sajtu ATS-a (www.ats.rs)



ANALYSIS REPORT

No:20 0190/16

Our reference: BO 2000219

Belgrade, 18th March 2016.

Client : Bakar Komerc Stil doo, Kovin
Commodity said to be : Copper slag (grit)
Scope of inspection : Analysis on as received samples

This is to report that we received sample of material said to be grit. Upon instructions received from Messrs Bakar Komerc Stil doo, Kovin, we performed analyses on sample as received.

Upon the request of our principal sample was submitted to SGS laboratory, Turkey for physical-mechanical characteristic (Mohs hardness test) and the findings reported by them in their work order No.TR1600445 dtd 17 03 2016. are as follows:

Sample	Hardness by Mohs
Cu slag/Grit	7.0000

- MOHS: Mohs hardness test



The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.



ANALYSIS REPORT

No:20 0191/16

Our reference: BO 2000219

Belgrade, 22nd March 2016.

Client	Bakar Komerc Stil doo, Kovin
Commodity said to be	Copper slag (grit)
Scope of inspection	Analysis on as received samples

This is to report that we received samples of material said to be copper grit. Upon instructions received from Messrs Bakar Komerc Stil doo, Kovin, we performed analyses on sample as received. Upon the request of our principal sample was submitted to Faculty of Chemistry, Belgrade for analyses on delivered sample and the findings reported by them in their report dtd 21.03.2016 are as follows :

Sample of Cu grit	Result	Method
Water soluble chlorides	0,63 ppm	ISO 11127-7
Conductivity of aqueous extract	18,58 mS/m	ISO 11127-6



These findings are reported herein for convenience only and SGS has no liability for the subcontracted results, which remain with subcontractor laboratory Faculty of Chemistry, Belgrade

The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

ANALYSIS REPORT No. 20 0215/16

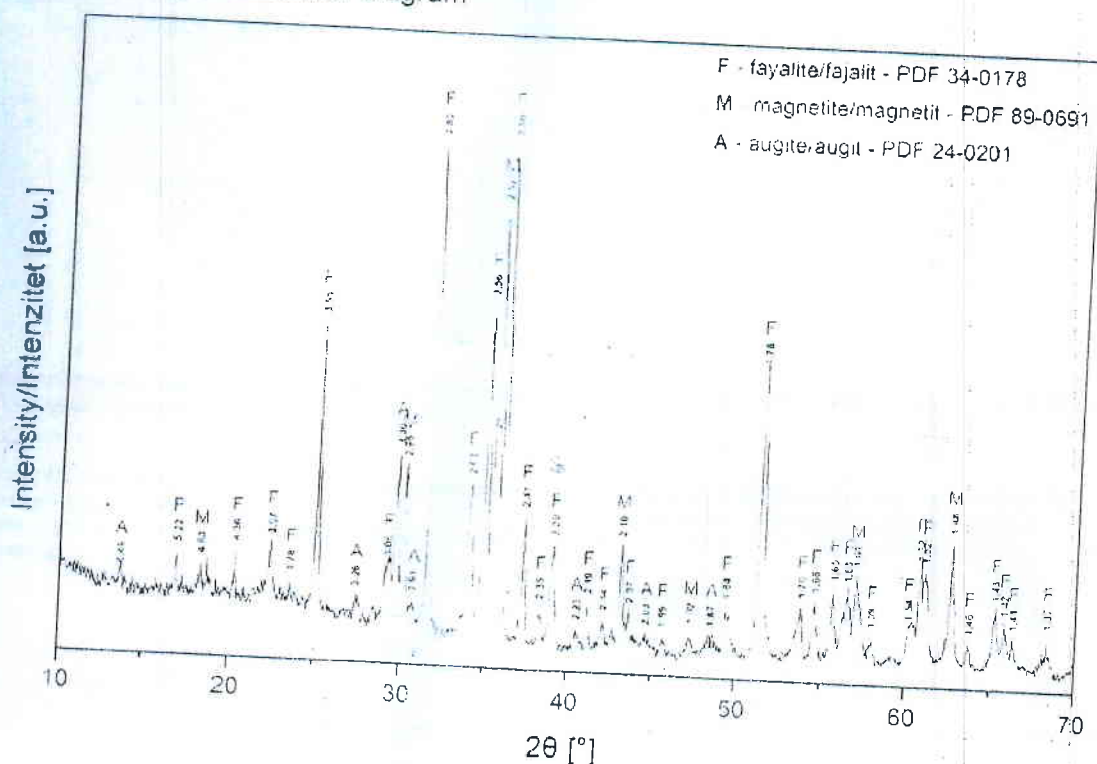
Commodity said to be :	Copper slag (grit)
Client :	Bakar Komerc Stil doo, Kovin
Sample received:	Analysis on as received samples

Upon the request of our principal Bakar Komerc Stil doo, Kovin we sent the received sample to subcontracted laboratory of Faculty of Mining and Geology, Belgrade and the findings reported by them in their report as per request no. No: 0321 3/07/2016 dtd 07.03.2016. were as follows:

The sample was analyzed by X-Ray powder diffraction (XRPD) method using PHILIPS PW 1710 diffractometer. The radiation source was $\text{CuK}\alpha = 1.54178 \text{ \AA}$ ($U = 40 \text{ kV}$, $I = 30 \text{ mA}$), and instrument was equipped with graphite monochromator. The data were recorded in $4 - 70 2\theta$ ($^\circ$) range with step size 0.02° , and step time 1.25 s . Determined diffraction peak positions 2θ ($^\circ$), and interplanar distances d ($\text{\AA}$), with corresponding intensities are given graphically (Fig. 1).

The crystal phase present in the sample was identified comparing the values of relative intensities I/I_{max} and d -values with literature data and ICDD PDF database.

Figure 1: Grit sample diffraction diagram



This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.



This is mostly crystalline sample. Three crystalline phases were identified. The most abundant crystal phase is fayalite (olivine), $(\text{Fe}^{2+})_2\text{SiO}_4$, rhombic symmetry, PDF card 34-0178 (over 60 wt %). Less abundant is spinel-magnetite, $\text{Fe}^{2+}(\text{Fe}^{3+})_2\text{O}_4$, cubic symmetry, PDF 89-0691. Augite (pyroxene) $\text{Ca}(\text{Fe,Mg})\text{Si}_2\text{O}_6$ monoclinic symmetry, PDF 24-0201 is the least abundant phase.

Za SGS
Mineral Sector



These findings are reported herein for convenience only and SGS has no liability for the subcontracted results, which remain with subcontractor laboratory Faculty of Mining and Geology, Belgrade

WARNING: The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted

This document is issued by the Company under its General Conditions of Service accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.



ANALYSIS REPORT

Client : Bakar Komerc Stil
Commodity said to be : Cooper grit A1 and B1
Scope of inspection : Analysis on as received samples
Our Reference : 14/1921/2500

This is to report that we received samples of material said to be cooper grit A1 and B1. Upon instructions received from Messrs Bakar Komerc Stil, we performed analyses on samples as received.

Upon the request of our principal sample was submitted to subcontracted IRM laboratory, Bor for chemical analyses and size test and the findings reported by them in their report No.15092 dtd 09.07.2014 and report No.14/2014 dtd 03.07.2014 are as follows:

Element	Result A1, %	Result B1, %	Analytic method
% H ₂ O	< 0.2	< 0.2	G
% SiO ₂	33.60	33.43	G
% FeO	41.65	40.45	V
% Fe ₂ O ₃	0	0	calculated
% Al ₂ O ₃	4.99	4.72	ICP-AES
% MnO	0.35	0.042	AAS
% CaO	6.70	1.44	AAS
% Cl	< 0.10	0.12	NTU
% Cu	0.24	0.74	AAS
% Pb	0.005	0.040	AAS
% As	< 0.003	0.018	ICP-AES
% S	0.96	0.71	ICP-AES
% Zn	0.59	0.60	AAS

SGS Beograd Ltd.

Jurija Gagarina 7b

11070 Beograd

Serbia

Tel. +381 11 39 78 773

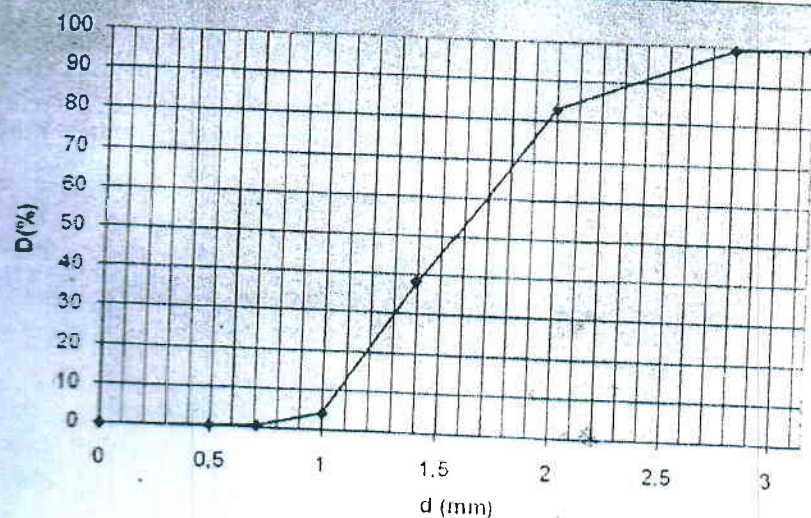
This document is issued by the Company subject to its General Conditions of Service (www.sgs.com/en/Terms-and-Conditions.aspx). Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein.
This document is to be treated as an original within the meaning of UCP 600. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any



These findings are reported herein for convenience only and SGS has no liability for the subcontracted results, which remain with IRM Laboratory, Bor.

RESULT OF SIZE TEST FOR SAMPLE COPPER GRIT A1

D (mm)	m (%)	R (%)	D (%)
-3,15+2,8	0,70	0,70	100
-2,8+2,0	16,20	16,90	99,30
-2,0+1,4	44,80	61,70	83,10
-1,4+1,0	34,00	95,70	38,30
-1,0+0,710	3,50	99,20	4,30
-0,710+0,500	0,40	99,60	0,80
-0,500+0,000	0,40	100	0,40



Graphical illustration of size test for sample copper grit A1

RESULT OF SIZE TEST FOR SAMPLE COPPER GRIT B1

D (mm)	m (%)	R (%)	D (%)
-2,8+2,0	4,15	4,15	100
-2,0+1,4	30,65	34,80	95,85
-1,4+1,0	54,60	89,40	65,20
-1,0+0,710	7,75	97,15	10,60

SGS Beograd Ltd.

Jurija Gagarina 7b

11070 Beograd

Serbia

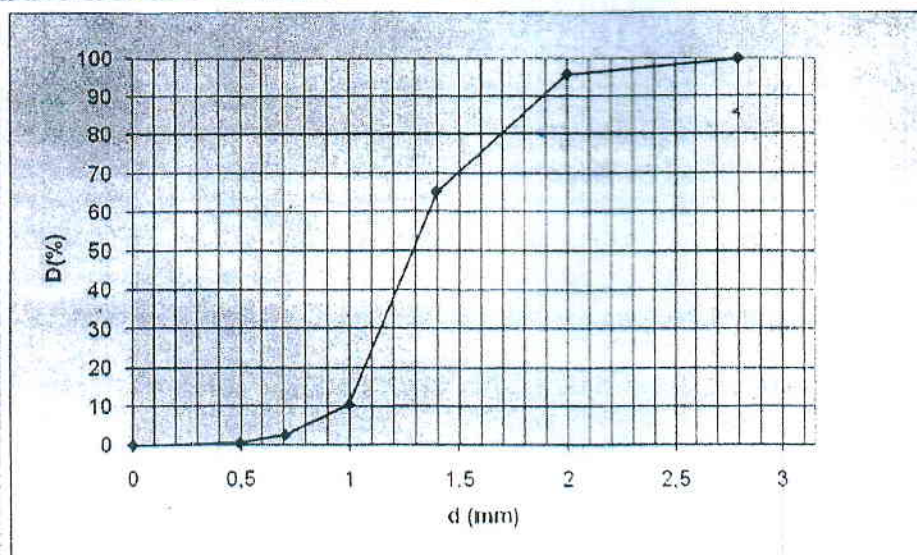
Tel.: +381 11 39 78 773

This document is issued by the Company subject to its General Conditions of Service (www.sgs.com/en/Terms-and-Conditions.aspx). Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein.

This document is to be treated as an original within the meaning of UCP 600. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any



-0,710+0,500	2,10	99,25	2,85
-0,500+0,000	0,75	100	0,75



Graphical illustration of size test for sample copper grit B1

Upon the request of our principal sample was submitted to subcontracted IRM laboratory, Bor for physical-mechanical characteristic and the findings reported by them in their report No.13/2014 dtd 16.07.2014 are as follows:

Sample	Hardness by Moss (1-10)	By description
Copper grit A1	6	Scratch the glass
Copper grit B1	6	Scratch the glass

Issued in Belgrade
09th July, 2014

For and on behalf of
SGS Beograd
Mineral Sector

The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

This document is issued by the Company under its General Conditions of Service accessible http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

SGS Beograd Ltd.

Jurija Gagarina 7b

11070 Beograd

Serbia

Tel.: +381 11 39 78 773

This document is issued by the Company subject to its General Conditions of Service (www.sgs.com/terms_and_conditions.aspx). Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein.

This document is to be treated as an original within the meaning of UCP 500. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is



INSPECTION REPORT OF RADIOACTIVITY

No: 2469/14

Our reference: 14/1921/2500

Belgrade, 30th June 2014.

Commodity said to be :	Cooper grit A1
Client / Principal :	Bakar Komerc Stil
Scope of Inspection:	Analysis on as received sample

Hereby we certify that, we received a sample of material said to be cooper grit A1. Upon instructions received from Messrs Bakar Komerc Stil, we performed analyses on sample as received.

Upon the request of our principal sample was submitted to subcontracted Institute of Nuclear Science "VINCA" – Beograd (sample marked as sample number 862) and the findings reported by them in their report No.1-588 dtd 27.06.2014 are as follows:

- Sample preparation: The preparation of the building material consisted of drying at 105°C, sifting and measuring in the appropriate measurement geometry (IAEA TRS 295). Radioactive equilibrium was not achieved in the sample.
- Measurement methods- The sample was counted using a high purity germanium detector (HPGe) with relative efficiency of 20 %, according to the method IAEA TRS 295
- Measurement results: are presented in the Table 1

Table 1. Radionuclide concentration in the sample (Bq/kg)

Sample no.	²²⁶ Ra	²³² Th	⁴⁰ K	¹³⁷ Cs
862	77±12	32±13	330±70	< 2

Measurement uncertainty is expressed as an expanded measurement uncertainty for the factor k=2 which corresponds to a normal distribution with a confidence level of 95%.

- Conclusion- based on the results and according to Regulation on limits of radioactive contamination of people, working and living environment and decontamination (Official Gazette RS.38/11 dated 31.05.2011.) we conclude that the sample meets criteria of the existing Regulation. The measurement results apply only to the tested sample.



These findings are reported herein for convenience only and SGS has no liability for the subcontracted results, which remain with Institute of Nuclear Science "VINCA" – Beograd.



The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.



INSPECTION REPORT OF RADIOACTIVITY

No: 2470/14

Our reference: 14/1921/2500

Belgrade, 30th June 2014.

Commodity said to be :	Cooper grit B1
Client / Principal :	Bakar Komerc Stil
Scope of Inspection:	Analysis on as received sample

Hereby we certify that, we received a sample of material said to be cooper grit B1. Upon instructions received from Messrs Bakar Komerc Stil, we performed analyses on sample as received.

Upon the request of our principal sample was submitted to subcontracted Institute of Nuclear Science "VINCA" – Beograd (sample marked as sample number 863) and the findings reported by them in their report No.1-589 dtd 27.06.2014 are as follows:

- Sample preparation: The preparation of the building material consisted of drying at 105°C, sifting and measuring in the appropriate measurement geometry (IAEA TRS 295). Radioactive equilibrium was not achieved in the sample.
- Measurement methods- The sample was counted using a high purity germanium detector (HPGe) with relative efficiency of 20 %, according to the method IAEA TRS 295
- Measurement results: are presented in the Table 1

Table 1. Radionuclide concentration in the sample (Bq/kg)

Sample no.	²²⁶ Ra	²³² Th	⁴⁰ K	¹³⁷ Cs
863	47±9	46±15	460±80	< 2

Measurement uncertainty is expressed as an expanded measurement uncertainty for the factor k=2 which corresponds to a normal distribution with a confidence level of 95%.

- Conclusion- based on the results and according to Regulation on limits of radioactive contamination of people, working and living environment and decontamination (Official Gazette RS.38/11 dated 31.05.2011.) we conclude that the sample meets criteria of the existing Regulation. The measurement results apply only to the tested sample.



These findings are reported herein for convenience only and SGS has no liability for the subcontracted results, which remain with Institute of Nuclear Science "VINCA" – Beograd.



The sample(s) to which the findings recorded herein (the "Findings") relate was(were) drawn and / or provided by the Client or by a third party acting at the Client's direction. The Findings constitute no warranty of the sample's representativeness of any goods and strictly relate to the sample(s). The Company accepts no liability with regard to the origin or source from which the sample(s) is/are said to be extracted.

This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.