4918423.2702703 5578440.2083333 32076306.745763 47679181396 41559052.4 39745050.444444 2210421966 67657391571 21360214.311111 44680904.571429 27383915520 140418123225 62976946803 87862221720 8037185900 14786276100 116965199344 24882768090 20022730.169014 7572376196 17568664.586957 1640869958

Disinfection of water treatment pdf online pdf format download

Water Treatment Handbook

Contents

King Saud University
College of Engineering
Civil Engineering Department

CE 442 Water Treatment
2nd Semester
Section:

First Mid-term Exam

Part one *(close book). Time allowed: 35 minutes*

Student Name: ……………………………………..
Student Number: ……………………………………..

Question One (20%)

For each statement, circle the most appropriate answer

(a) True .color of water is caused by:
a. dissolved solids. b. suspended solids. c. both a and b

(b) As the hydrogen ion concentration in solution increases, the pH:
a. increases b. decreases. c. stays as is.

(c) Solids left in a porcelain dish .after evaporation at 104.°C of a measured volume of a filtered water sample, is called:
a. suspended solids. b. total solids. c. dissolved solids.

(d) Conductivity of water can be used as a rough measure of:
a. total suspended solids, b. total dissolved solids. c. turbidity

(e) Alkalinity of natural water results from the presence of:
a. nitrates. b. carbon dioxides, c. bicarbonates

(f) Highly alkaline water often has:
a. a low level of dissolved solids. b. a high level of suspended solids.
c. a high level of dissolved solids.

(g) Permanent hardness of water is caused by presence of calcium and magnesium:
a. sulfates and chlorides. b. carbonates and bicarbonate,
c. bicarbonates and sulfates.

(h) Discharge of water containing high levels of ammonia nitrogen into water bodies is not desirable because ammonia:
a. is toxic to aquatic life. b. lowers the dissolved oxygen concentration.
c. both a and b.

(i) Eutrophication of water bodies is due to the presence of excessive concentrations of:
a. iron and manganese. b. nitrogen and phosphorus .
c. calcium and magnesium.

-1-

Disinfection of Potable Water Piping system & Tanks

Location: **Kuwait international Airport Terminal 2 - MPW Offices**

Introduction:

Disinfectant: is an agent applied to inanimate objects to destroy, neutralize, or inhibit the growth of disease-carrying microorganisms,

Chemical to be used is: Calcium Hypochlorite 70% active ingredient (Available Chlorine Content) concentration in Granular Form (Disinfectant)

Formula: $Ca(ClO)_2$

Description: A white crystalline solid, $Ca(OCl)_2 \cdot 4H_2O$, used as a bactericide, fungicide, and bleaching agent. Calcium hypochlorite is used for the disinfection of drinking water or swimming pool water

International Specification Standard
AWWA- B300-04: Hypochlorite. This standard describes chlorinated lime, calcium hypochlorite, and sodium hypochlorite for use in the treatment of municipal and industrial water supplies.
ANSI/AWWA Standard C651-92-The current industry practice for the disinfection of potable water distribution lines
Abbreviations used in Method Statement

1. **pH** which measure of degree of acidity (pH <7.0) and alkalinity (pH>7.0)
At pH 7.0 water is considered Neutral. pH is recommended to be between 7.2 to 7.6 for chlorine to be effective in achieving disinfection and oxidize bacteria.
pH reading is measured by pH meter

2. **Free Chlorine** (Cl_2): Measured by photometer, is the active part to oxidize bacteria and disinfect water.
The unit for measurements of free chlorine is mg/l (Milligram per Liter) or in PPM (Parts Per Million) – chlorine value is measured by photometer

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Swimming pool water treatment by ultrafiltration–adsorption process

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Received 27 November 2007; received in revised form 9 January 2008; accepted 12 January 2008
Available online 31 January 2008

Abstract

Disinfection by-products are of great concern in swimming pool water where water treatment generally involves a disinfection step with chlorine. In fact, swimmers can contribute a large quantity of organic matter that can lead to the formation of chloramines, chloroform and chloroacetic acids. These compounds can lead to health problems among the staff and pool users, especially babies or little children. The water quality improvement and productivity performance of the hybrid process, ultrafiltration–adsorption, is investigated. An original work, this paper presents results obtained in a real pool system for the first time. An industrial unit was installed in a municipal swimming pool in Marseille (France) and the process was studied for more than 18 months. After a study on water quality according to pool usage (activity and number of swimmers), the influence of transmembrane pressure and filtration time on ultrafiltration performance was evaluated. Optimal ultrafiltration operating conditions were found to be at a transmembrane pressure (TMP) of 0.45 bar and a filtration time (T_f) of 60 min for the entire range of each water quality parameter studied. The filtration unit enabled water clarification, and the adsorption step limited the concentration of combined chlorine in water to 0.35 ppm, well below the limit given by the French legislation (0.6 ppm). Due to a succession of filtration and backwashes, permeability never decreased below 160 L h^{-1} m^{-2} bar^{-1}. In spite of difficult conditions in terms of frequent pool usage and total chlorine concentration, the membranes have shown promising flexibility in this hybrid process.

Keywords: Ultrafiltration; Adsorption; Hybrid process; Swimming pool water; Hollow fibre

1. Introduction

Swimming pool water is governed by strict legislation in France, with the aim of insuring the safety of pool users. Pool water can be rapidly polluted by swimmers, who bring hairs, body fluids, cosmetics, etc. into the pool. Therefore, the water must meet different types of quality criteria including bacteriological, visual and chemical standards. Usually, water treatment includes in-line coagulation followed by sand filtration and enables the removal of suspended solids and a portion of the organic matter. Since swimming pool water can be contaminated by bacteria, viruses, protozoa and fungi, the water must be disinfected prior to use and act as a disinfectant (through the presence of free chlorine), destroying pathogenic micro-organisms as soon as they are introduced in the water. To limit the increase of contaminant concentration, purges are performed daily and fresh water is introduced at the rate of 50 L per swimmer.

Chlorinated compounds are the chemicals used most often for disinfection (i.e. sodium hypochlorite or gaseous chlorine). Chlorine can be present in several forms in water, each having a different disinfection power. Hypochlorous acid (HOCl) is the active form of chlorine, having the most potent disinfection power. When no stabilization compound is added, HOCl can dissociate in water into the negatively charged hypochlorite ion, OCl^-, depending on the pH of the water. The sum of HOCl and OCl^- is defined as free chlorine. Hypochlorite ion is considered as part of the free chlorine because it can react with H_3O^+ to form hypochlorous acid, which is the active chlorine compound. Active chlorine is subject to strict legislation, and its concentration must be between 0.4 and 1.4 ppm. Furthermore, combined chlorine is the general term used for all the chlorine disinfection by-products resulting from the reaction of

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Current Opinion in Chemical Engineering

Titanium dioxide-based antibacterial surfaces for water treatment

Changseok Han[1], Jacob Lalley[2], Devi Namboodiri[3], Keeley Cromer[2] and Mallikarjuna N Nadagouda[2]

The field of water disinfection has gained much interest since waterborne diseases caused by pathogenic microorganisms directly endanger human health. Antibacterial surfaces offer a new, ecofriendly technique to reduce the harmful disinfection byproducts that form in medical and food processing industries. Titanium dioxide (TiO_2) photocatalysts have been extensively studied to prepare antibacterial surfaces due to their environmentally favorable properties. The studies demonstrate TiO_2 improves the efficiency of disinfection by the effective inactivation of pathogenic microorganisms (i.e., *Escherichia coli*, *Enterococcus faecalis*, *Staphylococcus aureus*, *Pseudomonas putida*, and *Listeria innocua*). TiO_2 photocatalysts decompose natural algal toxins such as microcystin-LR and cylindrospermopsin under solar light irradiation. On the basis of literature review, these antibacterial surfaces may be applied to hospital, food, ceramic, and building industries or to environmental remediation where bacteria inactivation is required to ensure the safety of human health and the environment.

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Introduction

Water disinfection is a significant process for drinking water treatment since it is directly related to the reduction of waterborne diseases caused by pathogenic microorganisms [1–3]. Chlorination is a common technique used for water disinfection to inactivate or kill pathogens in water treatment plants. However, there are several disadvantages. During chlorination, harmful compounds known as disinfection byproducts (DBPs) are produced due to a reaction of chlorine and natural organic matter (NOM) in water. DBPs contain carcinogens (i.e., trihalomethanes (THMs) and haloacetic acids (HAAs)) and are associated with bladder concerns that may contribute to adverse productive effects [4,5**]. Moreover, it has been reported that after chlorination, multidrug resistant (MDR) pathogens (i.e., *Acinetobacter baumannii*, and *Pseudomonas aeruginosa*) grow and survive [5**,6–8]. Although new, alternative techniques, such as UV-disinfection and ozonation, have been studied and employed in water treatment plants to solve these problems, complications regarding residual of pathogens have still been reported [5**]. Therefore, there is a need to develop a reliable method of disinfection, which is free from the production of DBPs and effective at killing or inactivating pathogens. Also, further studies are required to ensure that new techniques do not have adverse effects to the safety of human health and the environment.

One alternative approach of disinfection is utilizing antibacterial surfaces. Antibacterial surfaces offer a different technique compared to conventional disinfection since water-containing pathogens require contact with the antibacterial surfaces to kill or inactivate pathogens as opposed to chemicals (e.g., chlorine, chloramines, and chlorine dioxide) that are directly dispersed into water [5**]. Hitherto, antibacterial surfaces have been used in medical fields to prevent infection and the formation of biofilms on the surface of medical devices and implants [5**,9]. Recently, the antibacterial surfaces prepared on different substrates, such as stainless steel, glass, and ceramics, have been used for water treatment [10**].

Because of its antibacterial activity, titanium dioxide (TiO_2) has been extensively studied and used to inactivate many microorganisms [11,12*,13]. Also, being environmentally suitable, it has been widely used for environmental applications, including water and air purification as well as groundwater and soil remediation [14*,15*,16,17]. Therefore, in this review, we focus on the antibacterial surfaces of TiO_2 for drinking water disinfection.

Titanium dioxide

TiO_2 is the most commonly used semiconducting photocatalyst and one of the most studied nanoparticles for

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The sources of groundwater can be disinfected by "the rule of water treatment", which requires public water systems for disinfection. It should be noted that a new lamp could lose its intensity of 20% in the first 100 hours of operation. In addition, configurations of the system of pipes should be avoided which will trap sodium naocl between two closed insulation valves or the re -lips valves. A calibration cylinder, a pulsation shutter, a pressure download valve and a loading valve are the main components of a dosage system. Introduction to small water systems. Some forms of chlorine may react with these organic materials and cause the formation of harmful by -products; The United States environmental protection agency has anticipated the maximum levels for these contaminants. Chlorination chlorination Lightfotocitaltic disinfectionkilling, removal or deactivation of harmful microorganisms can be defined disinfection. 2013 April-Jun; 10 (2): 143-8, 7 pages17. 2013. It is also widely used as a water disinfectant, but it may not be the most economic solution as it is more expensive for gas. However, there is a limitation of 1 ã ¢ mg/l of chlorine at the point of application of the recovery water. Design could influence the control of the gas from the mass hypoclory in dosage pumps and in the pipes and in the formation of the scale. The containment of the spill should be provided for the NOOCL storage tanks. The organic material is naturally present in the water. This chapter is distributed according to the terms of the Creative Commons attribution 3.0 license, which allows use, distribution and reproduction without restrictions in any means, provided that the original work is adequately .eroirefni .eroirefni atacilppa orolc id esod anu e emirp id atidrep etneugesnoc noc ,oidos id otirolcopi'llen itloicsid sag ied enoizazzirpoav al acovorp otouv lI .icidod feirb gnincteT a positive head on the pump suction (with pump inlet always below the minimum tank liquid level). Hydrogen is also produced during electrolysis, and it needs to be vented because of its explosive nature [7].These dosing systems are mostly simple, but there might be a concern regarding the design. Chlorine gas is mostly used as a water disinfectant. The flow arises from the holes in the sieve plate that results in eroding the last layer of tablets. Disinfection Technologies for Potable Water and Wastewater Treatment: Alternatives to Chlorine Gas. In comparison to the conducting materials, the recombination of holes and electrons is relatively slow in TiO2 recombination in metals occurs immediately [20].AdvertisementWater can be affected by environmental factors. PRV¢ÂÂÂs operation must be detected and alarmed: e.g., the outlet of the valve could be directed to a small ¢ÂÂÂcatch-pot,¢ÂÂÂ equipped with a float switch. Bromines are weaker disinfectants, thus the efficacy is reduced [14].Ozone is produced by applying high voltage electricity to a gap (tube) containing pure oxygen or filtered dry air (corona discharge method).The high voltage electricity results in the formation of ozone by recombining oxygen. Chlorination can lead to the formation of by-products or toxic chemicals that are hazardous to aquatic life. 2013 Apr-Jun;10(2):143-8, 7 Pages7. Chlorine and alternative disinfectants guidance manual. United State: ACR Publications. Liquid bleach has a better POU application because of its availability and relative manageability [1] (FigureÂ Â2).Chlorination by chlorine liquid method.Ca(OCl)2 (calcium hypochlorite) is an essential solid that can be used in replacement of NaOCl (liquid). It does not act as a secondary disinfectant as it does not work against reinfection in water.A concern regarding the UV disinfection is chemical composition and the quality of microorganisms present in the influent water. 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The NaOCl solution is a corrosive liquid with a high pH, i.e. 12. Less chemical input is required and reaction time is modest. It can be applied to hydrogen generation, gaseous phase and aqueous treatments, as well as solid phase treatments (soil) to a certain extent [17]. For the effective TiO2 application in water treatment, the limitation of mass transfer must be minimized as the photocatalyst degradation occurs mainly on the surface of TiO2. Three main processes influence ozone release after the introduction of ozone in water: decomposition, reaction with impurities of water and undress in the atmosphere [14]. Ozone is produced by a gas containing oxygen (usually air or pure oxygen). Chlorine cylinders can be 150 pounds. Brief T. Moreover, for the slurry system, one of the main practical challenges to overcome is to recover the particles of TiO2 nanosized from treated water regarding both economic concern and safety concern. To overcome these limitations of TiO2-based photocatalysis, the following countermeasures have been adopted in previous studies: Change of the TiO2 catalyst in order to achieve the use of visible light. The catalyst synthesis should be optimized to obtain catalysts with crystalline structure, high affinity to various organic pollutants, and smaller particle size. Development and design of the second generation catalyst of TiO2, with high separation capacity, which can be recovered and regenerated effectively. The purpose of these changes and developments is to improve photocatalytical efficiency, complete degradation of organic pollutants, improve the absorption of visible light, improve stability andand improve the recycling skills and reuse of Tio2 [18]. The photocatal reaction depends mainly on light (photon) energy or wavelength and catalyst. Interchopen licensee. UV light or crown discharge process is used ozone generation. It has applications in both waste water and drinking water [7].Being solid, Ca(OCl)2 is more safer than chlorine gas and NaOCl.It even has excellent stability when stored in dry place, maintaining its potency well over time [7].Contamination or improper use of Ca(OCl)2 may lead to explosion, fire, or the release of gases (toxic gases). ISSN: Electronic version: 1984-5685, RSBO. Introducing chlorine to water plays a very effective role for removing almost all pathogenic microorganisms. These sediments settle down at the bottom of the ballast tanks during voyage. John Piatt & Ann Lesperance. The whole plumbing system should be disinfected by a chemical (preferably chlorine) before relying on the process.UV lights loses effectiveness with usage, the lamp should, therefore be properly cleaned on regular basis and replaced once in a year. Tech E. 199312. It is a very strong, oxidizing agent. The hypochlorite and hypochlorous ions will be present in equal concentrations at pHÃ Â7.3. At pH above 8.3, the hypochlorite ion predominates which is not a better disinfectant. Almost 70% of chlorine is available in commercial grades of Ca(OCl)2. Controlling the natural systems like detention lagoons is difficult.A major environmental risk associated with lagoon-based disinfection is the excessive growth of undesirable organisms, such as blue-green algae. Turbid, cloudy, or the water containing a large number of bacteria can be used to shield bacteria. Only softened water and high grade salt (NaCl) is used.As compared to the standard supplied solution (14% concentration), sodium hypochloride (NaOCl) solutions are less hazardous (1% concentration) and less concentrated while generating onsite production [7]NaOCl can be commercially supplied or generated on-site, the latter being the safer of the two methods for handling reasons. The sediments contain the microbes that are difficult to treat like bacterial colonies Viral clump. Office for water management of drinking water. One or more raft water are equipped with ozone injection equipment that act as contact rooms. RSBO Magazine Sul. Gasification (mainly producing oxygen) can lead to the formation of steam or gas bubbles, especially if sodium hypochlorite is below atmospheric pressure, which leads to the gas block of the suction line in a diaphragm. To reach a long contact time, that raft water must be pumped into these contact tanks. The most famous by-products of chlorination are chlo-organic and trihalomethane (THM). It has been identified in many studies that some of these chlo-organic are mutagenic, toxins or carcinogens. There are no changes in taste and color that is an advantage of this method. Article: Tech Brief â€ ¢ Cloration, autumn 2004, vol. If a long contact time is required against specific microorganisms, during the trip it is necessary to carry out the treatment to allow longer contact times. Organic carbons are associated with sediment formation. 2012; 2 (4): 572-60120. Ozone gas could damage the environment due to its corrosive nature. Microfiltration poses a risk to the environment only if a leakage of cleaning agents or contaminated waste of counterwash is erroneously eliminated. No re-use option is available for UV lamps. Authors also recognize the guidance of other members of the Department faculty for their guidance and suggestions. Khayyat Ama. Â Study on the methods of treatment of the point of use for the disinfection of drinking water in Nepal [PhD]. These solutions may contain chlorate. In terms of potential environmental cost, it would seem that UV, lagoon and microfiltration have the leastto have a negative impact on the environment, followed by ozonation and then cloning. The point where free chlorine is available for continuous disinfection is defined as the breakpoint. Calcium hypochlorite should not be allowed contact any foreign matter (including other water treatment products). Ozone is surpassed only by the hydroxyl radical (¢ÂÂ¢ÂOH) and fluoride in its oxidation capacity [7, 12].Following are the advantages when ozone is used to treat water:Ozone possesses strong oxidizing powerShort reaction time is needed so germs (including viruses) are killed in a few secondsNo change in color and taste occurs.Requires no chemicalsOxygen is provided to water after disinfectionDestroys and removes algaeOxidizes iron and manganeseReacts with and removes all organic matter [13].Onsite generation is necessary as ozone is unstable at atmospheric pressure. A great concern might be the byproducts and incompletely oxidized compounds present in chlorinated water that increases its toxicity. South Africa: University of South Africa, Water Research Commission. By reducing the degradation of NaOCl, the formation of chlorate can be minimized by avoiding high temperatures, reducing light exposure, and through limiting storage time. Tanks must be properly vented out of all structures to the atmosphere.Most commonly available dosing systems use diaphragm metering pumps. Ultraviolet radiation for disinfecting household drinking water. Regular controlled environment is needed as the solution is affected greatly by the pH, light, heat, and heavy metals [6].Sodium hypochlorite can also be used as a disinfectant.Both sodium hypochlorite and chlorine gas shows similar disinfection effectiveness.As compared to chlorine gas, sodium hypochlorite disinfection reduces the hazards in storing and handling.No hazardous chemicals are used in onsite generation. However, the manufacture, storage, and transportation of chlorine products still pose a risk to the environment.Toxic by-products are formed by the oxidation of ozone. The well-known THM chloroform is an animal carcinogen. pp.Ã Â19-4018. Massachusetts Institute of Technology; 20002. Ca(OCl)2 must be kept heat, i.e. flame, heat, and any kind of burning materials [7]. ichloride calcium chloride contains a cylindrical polyvinyl chloride (pvc) with a height of 0.6–1.2 m and a diameter of 230–610 mm. Therefore, general precaution measures to treat corrosive materials should be used as avoiding metal contact, including stainless steel. a method acceptable to disinfect waste water reuse is cloning. search on the water. the ozone produced will dissociate immediately so the on-site generation of ozone should be done. one of the important features is also contact time. heat exposure can cause Ca(OCl)2 to decompose quickly, which can lead to explosion, intense fire, and release of toxic gases. Chloration is the best method for reuse applications when a residue is necessary for microbial regrowth. humans are at high risk as blue-green algal flowers produce toxins. Ca(OCl)2 is oato as a strong oxidizing agent. the product must be added to the water instead of adding water in the product. great care should be taken so that concentrated chlorine and ammonia are never mixed as they form nitrogen trichloride, a potentially explosive compound [11]. ozone is an allotropic (non stable) formula of oxygen in which three molecules are combined to produce a new molecule. lindsay l. in many systems, power supply cannot be guaranteed. a limitation may be that there is not even a single test available to examine the correct disinfection of rays. ozone for phenol treatment in industrial waste water. chlorine dosing rate can be calculated by controlling water flow through chloride. properly calibrated uv detectors help the owner to alert whenof the light goes down under a certain level. The water treated by UV rays must be monitored regularly due to the presence of heterotrophic bacteria and monthly coliform bacteria (first 6 months of use of the device). However, however, Environmental risks are associated with the direct use of chlorine. Sassi J, Viitasalo S, Rytkonen J, Leppakoski E. published by The National Environmental Services Center at West Virginia University, Morgantown. Environmental protection agency. No change in taste and color occurs. Saravanan R, Gracia F, Stephen A. Fundamental principles, mechanism and challenges of photocatalysis. They have a full value band and a vacant conduction band. The fundamental steps in the process of photocatalysis of the semiconductors are as follows: when the light energy in terms of photons falls on the surface of a semiconductor and if the energy of the incident radius is equivalent or more of the energy of the semiconductor bandgap, the Electrons of the Valenza band move to the semiconductor conduction band. The band of semiconductor valves is left with the holes. To meet the operating requirement, the effluent chloride is returned to the main flow, providing the desired level of available chlorine. Variation in the dose and the contact time can be done to calculate the disinfection required. It can be produced easily. They play an important role in providing residual protection in the distribution system. Ozone chlorination, ozone, ultraviolet light and chlorine are primary methods for disinfection. Being liquid, it can be easily managed that gas or calcium hypochlorite, but is limited by its lack of determination and corrosive nature. To reduce the formation of sediments and the fine particles to enter the treatment process, the treatment of the ozone must undergo a preliminary treatment (filter or cyclone). The Zavorra treatment ensures that all the water present in ballast tanks is exposed to the ozone at the beginning of the trip. Both forms (liquid and gas) can be stored and used by gas cylinders aicaciffe'l aicaciffe'l eratulav rep itazzilitu etnemroiretlu eresse onossoP .odiuqil atnevid sag li ,enoisserp atla odnenroF .7102 ;regnirpS :mahC .enoisserp oiramirp etnattefnisid emoc olos ecaciffe Ã .otloicsid onegisso id eiceps noc enoizudnoc id adnab alled inorttele ilg odnegaer itamrof onos odissorepus id inoi ilG .irotanod id elocelom el odnadisso icilissordi ilacidar erareneg rep auqca'd elocelom noc erigaer onossop irof itseuQ .A ecnarepseL ,J ttaiP ,L nawS-nedwonS .aira ni erevoumir ad onozo id Âtitnauq al eratimil id olleuq ¨Ã erotturtsid led elapicnirp opcos oL .la ¢Âte ,X eH ,C gnahZ ,C naF ,L gnaT ,G gneZ ,H gnoD .oiradnoces ehc oiramirp etnattefnisid emoc ais otasu eresse ²ÂuP .isilatacotof atinifed ¨Ã erotazzilatac nu id azneserp ni enoizarotof anu id enoizarelecca'L .VU ad enoizefnisiD .)5 arugiF( ]7[erotarepo'l ,enoizisope'l erative reP .arres sag nu ¨Ã otnauq ni inoizartnecnoc etla ni ocissot Ã .aittalam al onasuac ehc imsinagrorcim i erediccu rep auqca'lla itnuigga onognev itnattefnisid I .otirolcopi e osorolcopi odica art orolc led enoizubirtsid allus eriulfni ebbertop eulfer euqca elled Hp lI .onatemolahirt li onamrof is ,idica itseuq noc ecsigaer orolc li odnauQ .)itazzirusserp ibut(enoizeini id odroccar nu osrevartta o otrepa elanac nu id onretni'lla asremmi erotigraps id arrab anu osrevartta atasod eneiv LCOaN aL .onozo id enoizamrof al acifirev is e onegisso id elocelom elled aruttor al acovorp ocirttele opmac lI .apmop allad angesnoc id otal lus ehcna otinrof eresse ebbervod)enoisserp a ocirasc id alovlav(VRP nU ,aruttor allad ammarfaid li ereggetorp reP .enoizaripsa id otal lus atallatsni ¨Ã enoizaripsa id adnamod id alovlav anu odnauq a onif ,lrab 0,1° 7,0

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