

Corrosion Inhibitors for Steel in Concrete

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Abstract

Corrosion of reinforcing steel represents the most widespread form of deterioration of concrete structures resulting in significant costs for repair and replacement worldwide. Despite the huge demand, a simple, cheap and reliable technique that either protects the steel in concrete from corrosion or at least lowers its corrosion rate is still lacking. The concrete repair industry has developed novel techniques that are claimed to prevent the steel from corrosion and/or to restore the protective character of the cover concrete by introducing corrosion inhibitors into the carbonated or chloride contaminated concrete.

Inhibitors, chemical substances that prevent or retard corrosion, are applied as concrete admixtures or as surface applied liquids both for preventive or for restorative applications. A short review on literature results regarding the performance of the most frequently used inhibitors for steel in concrete in laboratory and in field tests is given, in particular two inorganic inhibitors, calcium nitrite (DCE) and MFP, and several organic inhibitors, the „migrating inhibitors“ (MCI or SIKA) and an organic corrosion-inhibiting admixture (OCI) are addressed. The problem of transport of inhibitors into concrete is discussed. A critical review of corrosion inhibitors to be used on reinforced concrete structures regarding concentration dependance, durability and measurement and control of the inhibitor action is given.

Keywords: inhibitor, admixtures, surface applied, corrosion, adsorption, transport, durability

Introduction

In general, reinforced concrete has proved to be successful in terms of both structural performance and durability. However, there are instances of premature failure of reinforced concrete components due to corrosion of the reinforcement. The two factors provoking corrosion are the ingress of chloride ions from deicing salts or sea water or the reaction of the alkaline pore solution with carbon dioxide from the atmosphere, a process known as carbonation. Despite of the huge demand, a simple, cheap, and reliable technique which either protects the steel from corrosion or at least lowers its corrosion rate is still lacking. Over the past decade, however, concrete repair industry has developed novel techniques that are claimed to prevent or at least reduce corrosion of steel in concrete. The use of these „corrosion inhibitors“ is of increasing interest as they can be used in reinforced concrete either as preventive measure for new structures (addition to the mixing water) or as surface applied inhibitors for preventive and restorative purpose. Addition to the mixing water does not require any additional working steps and allows a simple handling of the inhibitor, unless it affects the properties of the cement paste adversely. Application from the concrete surface could be a promising technique to protect already existing structures from corrosion or increase the lifetime of structures that already show corrosion attack. The application of inhibitors on the concrete surface requires the transport of the substance to the rebar where it has to reach a sufficiently high concentration to protect steel against corrosion or reduce the rate of the ongoing corrosion.

Very often the long experience with chemicals operating as corrosion inhibitors e.g. in the oil field, gas or petroleum industry is taken as an example for the successful use of corrosion inhibitors, transferring this success also to applications on reinforced concrete. This is a priori not correct because the mechanism of inhibitor action are completely different:

- in the application of oil and gas industry (and most others) the steel to be protected is uniformly corroding in slightly acidic or neutral media. Thus the inhibitors have to protect the bare metal surface, e.g. as adsorption inhibitors acting specifically on the anodic or on the cathodic partial reaction of the corrosion process or as film forming inhibitors blocking the surface more or less

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web cara menghitung kebutuhan semen dan pasir pada pasangan batako dengan campuran 1 pc 6 pp batako yang digunakan adalah yang memiliki ukuran 10 x 20 x 40 cm dalam mengerjakan dinding seluas 1 m 2 yang sesuai dengan kebutuhan lapangan maka material semen pc yang dibutuhkan adalah 1 74 kg serta pasir pp 0 0086 m 3

2 cara menghitung biaya pemasangan batako 2023 - Jun 30 2023

web luas tembok 44 8 2 3 0 96 41 54 m² setelah mendapatkan total volume pekerjaannya maka cara menghitung biaya pemasangan batako selanjutnya yaitu mengalikan luas tembok dengan harga per meter persegi di atas biaya pasang batako luas tembok x harga per meter biaya pasang batako 41 54 m² x rp 106 497 rp

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web pada saat proses pemasangan dinding dan mempercepat pelaksanaan ukuran batako standar menurut sni 03 0349 1989 adalah sebagai berikut tabel 3 3 tabel 3 3 ukuran batako standar kelebihan dinding batako press dibandingkan dengan batu bata pembuatan mudah dan ukuran dapat dibuat sama ukuran yang besar membuat waktu

analisa perhitungan biaya pemasangan batako sni per meter - Oct 03 2023

web dec 16 2021 total dari biaya yang dikeluarkan untuk pemasangan batako per meter yaitu jumlah dari total biaya material dan jenis pekerja sebesar rp64 897 rp41 600 rp106 497

analisa pasangan batu bata merah untuk pekerjaan dinding - Oct 23 2022

web dec 16 2021 berikut ini merupakan contoh daftar analisa harga satuan memasang 1 m² dinding bata merah dengan ketebalan ½ bata pasangan ketebalan ½ bata campuran spesi 1pc 2pp pasangan ketebalan ½ bata campuran spesi 1pc 3pp pasangan ketebalan ½ bata campuran spesi 1pc 4pp pasangan ketebalan ½ bata campuran

cara mudah menghitung jumlah kebutuhan material batako - Mar 16 2022

web nov 1 2022 kebutuhan material batako dipasang rebah 1 m² 0 0361 m² 27 70 buah dibulatkan menjadi 28 buah m² pasangan batako secara tegak maka luas penampang untuk 1 batako ditambah tebal adukan spesi adalah 0 17 0 02 x 0 36 0 02 0 0722 m² kebutuhan material batako dipasang tegak 1 m² 0 0722 m² 13 85 buah

cara menghitung biaya pemasangan tembok bata arsitur studio - May 30 2023

web sep 3 2019 biaya tembok 41 54 m² x rp 196 499 60 m² biaya tembok 8 162 593 38 atau dibulatkan menjadi rp 8 200 000 00 termasuk biaya air dan lain lain perlu diketahui bahwa biasa pemasangan tembok bata lebih besar daripada batako namun dari segi ketahanan tembok bata lebih kuat dan tahan lama

jumlah kebutuhan batako untuk dinding rumah harga satuan - Sep 21 2022

web nov 5 2012 dinding batako bisa menjadi alternatif untuk membuat rumah tembok jenis material batu buatan ini banyak digunakan karena kecepatan dalam waktu pemasangan serta dapat lebih menghemat penggunaan adukan jika dibanding pasangan dinding batu bata disini kita akan coba menguraikan cara menghitung jumlah kebutuhan batako

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cara menghitung biaya pemasangan tembok batako arsitur - Sep 02 2023

web jun 9 2020 biaya tembok luas tembok x harga per meter biaya tembok 41 54 m² x rp 117 146 70 m² biaya tembok 4 866 273 92 atau dibulatkan menjadi rp 4 900 000 00 termasuk biaya air dan lain lain demikianlah mengenai cara menghitung

biaya pemasangan tembok batako semoga bermanfaat dan dapat menambah wawasan

biaya dan durasi pemasangan dinding batako pada rumah tipe - Feb 24 2023

web jun 1 2018 tabel 6 ahsp pemasangan 1m conblock hb 10 campu no uraian satuan koefisien harga satuan biaya a tenaga
1 pekerja oh 0 3 rp 50 00 0 rp 1 4 61 900 2 tukang batu oh 0 1 rp 65 000 rp 633 490 3

analisa harga satuan pekerjaan pasangan dinding - Apr 16 2022

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sesuai standard sni harga satuan upah dan bahan menyesuaikan lokasi kerja proyek a 4 4 1 1 pemasangan 1m2 dinding bata
merah 5x11x22 cm tebal 1 batu campuran 1sp 2pp a 4 4 1 2

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biaya may 08 2020 dari tanah jadi rumah jun 01 2022 membangun rumah idaman adalah impian setiap orang analisa harga
satuan pekerjaan ahsp bidang umum may 12 2023

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web satuan pasir pasang m³ 0 520 203 000 00 pekerja org 1 500 tukang batu org 0 750 kepala tukang org 0 075 mandor org
0 075 total harga 8 1 m² pasangan dinding batako batu bata bh 25 000 2 500 00 semen pc zak 0 230 85 000 00 pasir pasang
m³ 0 043 203 000 00 pekerja org 0 300 tukang org 0 100 kepala tukang org 0 010