

الآية

قال تعالى:

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿إِنَّ فِي خَلْقِ السَّمَاوَاتِ وَالْأَرْضِ وَخُلُقِ الْأَيْلِ وَالنَّهَارِ وَالْفَلَكِ الَّتِي تَجْرِي فِي الْبَحْرِ بِمَا يَنْفَعُ النَّاسَ وَمَا أَنْزَلَ اللَّهُ مِنَ السَّمَاءِ مِنْ مَاءٍ فَأَحْيَا بِهِ الْأَرْضَ بَعْدَ مَوْتِهَا وَبَثَّ فِيهَا مِنْ كُلِّ دَابَّةٍ وَتَصْرِيفِ الرِّيَاحِ وَالسَّحَابِ الْمُسَخَّرِ بَيْنَ السَّمَاءِ وَالْأَرْضِ لِآيَاتٍ لِقَوْمٍ يَعْقِلُونَ﴾

صدق الله العظيم

سورة البقرة الآية (١٦٤)

DEDICATION

To my father..

To my mother..

To my husband..

ACKNOWLEDGEMENTS

In preparing this thesis, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts.

*In particular, I wish to express my sincere appreciation to my main Thesis supervisor, **Dr. Ali Eltom Hassaballa** for encouragement, kind help and guidance.*

Thanks and appreciations are also extended to university of Gezira representing in concrete lab department for making the experimental works.

Extend thanks and utmost respect and appreciation to my friends, Engineer Zainab Mustafa Suleiman, and engineer Salma Abdeen, who stood next to me in my career Scientific.

Finally, I would like to take the opportunity to thank my parents and family for having supported me through the all project and studies.

ABSTRACT

This research aims to study the effect of superplasticizer, when mixed with local materials, on both fresh and hardened concrete properties to achieve the demands of engineers and contractors.

The methodology adopted to achieve the objectives of the research focuses mainly on a collection of data from different sources, an extensive review of previous studies, designing concrete mixes and implementing a lot of laboratory experiments using different ratios of super plasticizer with low water contents. The ratios of superplasticizer added were 0.0 (as a reference mix), 0.4, 0.8, 1.2 and 1.5 Litre/ 50Kg cement for concrete ages of 3, 7 and 28 days by preparing 12 cubes for each sample. Local ordinary Portland cement (OPC) and graded natural coarse and fine aggregate were used for all concrete mixes conducted in this research.

From the experimental results obtained it has been found that the ratio of (0.8 litres per 50 kg of cement) superplasticizers with a reduction of 15% (w/c) showed a clear and significant effect on improving the workability and compressive strength of concrete mixes. Also the ratios of 1.5L per 50 kg of cement with a 30% reduction of (w/c) and 0.4L per 50 kg of cement with a reduction of 10% (w/c) superplasticizer have resulted in high workability and good compressive strengths. The results have shown substantial improvement in the properties of concrete after use of the superplasticizers for achieving the lowest possible water/cement ratio while maintaining a high workability and an increasing compressive strength of concrete.

الملخص

يهدف هذا البحث إلى دراسة تأثير الملدනات الفائقة عند مزجها مع مواد الخرسانة المحلية، على كل من خواص الخرسانة الطازجة والمتعلقة لتحقيق مطالب المهندسين والمقاولين.

المنهجية المتبعة لتحقيق أهداف البحث ترتكز أساساً على جمع البيانات من مصادر مختلفة، مراجعة شاملة للدراسات السابقة، تصميم الخلطات الخرسانية وتنفيذ الكثير من التجارب المعملية باستخدام نسب مختلفة من الملدනات الفائقة مع محتويات الماء المنخفضة. وكانت نسب الملدن المتفوق المضافة . . . (الخلطة المرجعية)، ٤، ٠، ٨، ٠، ٨، ١.٢ و ١.٥ كجم الأسمنت لأعمر محددة من ٣ و ٧ و ٢٨ يوم، بإعداد ١٢ مكعب لكل عينة. استخدم الأسمنت البورتلاندي العادي المحلي (OPC) والركام الخشن الطبيعي المتدرج والركام الناعم لجميع الخلطات الخرسانية التي أجريت في هذا البحث. من النتائج التجريبية التي تم الحصول عليها فقد وجد أن نسبة (٨.٠ لتر لكل ٥٠ كجم من الأسمنت) ملدනات فائقة مع تخفيض ١٥٪ (م/س) أظهرت تأثير واضح وكبير على تحسين قابلية التشغيل وقوه الضغط للخلطات الخرسانية. كما ان نسب ٥٠ لتر لكل ٥٠ كجم من الأسمنت مع تخفيض ٣٠٪ (م/س) و ٤٠ لتر لكل ٥٠ كجم من الأسمنت مع تخفيض ١٠٪ (م/س) وتخفيض ١٠٪ اسمنت ملدن متفوق نتجت في قابلية تشغيل عاليه ومقاومة ضغط جيدة . وقد أظهرت النتائج تحسناً كبيراً في خصائص الخرسانة بعد استخدام الملدනات الفائقة لتحقيق ادنى تخفيض ممكناً لنسبة الماء / الأسمنت مع الحفاظ على القابلية وقوه الضغط العاليه والمترادفة من الخرسانة.

Table Contents

Subject	Page
الأية القرآنية	I
DEDICATION	II
ACKNOWLEDGEMENTS	III
ABSTRACT IN ENGLISH	IV
ABSTRACT IN ARABIC	V
TABLE OF CONTENTS	VI
LIST OF TABLES	VIII
LIST OF FIGURES	XI
Chapter One: Introduction	
1.1 Introduction	1
1.2 Statement of the Research Problem	3
1.3 Objective of the Research	3
1.4 Methodology of the Research	3
1.5 Research organization	4
Chapter Two: Literature Review	
2.1 Historical Background	5
2.2 Effects of Superplasticizers on Properties of Concrete	6
Chapter Three: Mineral and Chemical Admixtures	
3.1 Introduction	11
3.2 Mineral Admixtures	11
3.3 Chemical Admixtures	13
3.4 Handling and storage of admixtures	22
Chapter Four: Experimental Results and Discussion	

4.1 Introduction	24
4.2 Preliminary Tests Results of Cement	25
4.3 Results of Aggregate Tests	27
4.4 Results of workability (slump) for Fresh Concrete Tests	31
4.5 Results of Hardened Concrete Tests	33
4.6 Results of Concrete Water Absorption Tests	56
4.7 Discussions of the Results	62
Chapter Five: Conclusion and Recommendations	
5.1 Conclusions	65
5.2 Recommendations	66
References and Appendices	
References	67
Appendix A: Data Sheet of Superplasticizer	70
Appendix B: Mix Design and Laboratory Images	75
Appendix B.1: Mixes Proportions	76
Appendix B.2: Tables and charts for mix design:	77
Appendix B.3: Pictures	81

List of Tables

Table No	TITLE	Page
(4-1)	Results of Preliminary Cement Tests	26
(4-2)	Results of sieve analysis of coarse aggregate test	27
(4-3)	Results of sieve analysis of fine aggregate test	29
(4-4)	Silt content in fine aggregate	30
(4-5)	Results of Slump test improved by Superplasticizer ratios and water reduction	31
(4-6)	Results of Slumps test improved by Superplasticizer ratios with (water and cement) reduction	32
(4-7)	Results of compressive strength for control mixes (w/c = 0.48 and superplasticizer = 0)	34
(4-8)	Results of compressive strength improved by (0.4L per 50kg of cement) superplasticizer and 10% water reduction	35
(4-9)	Results of compressive strength improved by (0.8L per 50kg of cement) superplasticizer and 15% water reduction	36
(4-10)	Results of compressive strength improved by (1.2L per 50kg of cement) superplasticizer and 20% water reduction	37
(4-11)	Results of compressive strength improved by (1.5L per 50kg of cement) superplasticizer and 30% water reduction	38
(4-12)	Results of compressive strength improved by (0.4 L per 50kg of cement) superplasticizer, 10% water reduction and 10%	39

	cement reduction	
(4-13)	Results of compressive strength improved by (0.8 L per 50kg of cement) superplasticizer, 15% water reduction and 15% cement reduction	40
(4-14)	Results of compressive strengths developed by using different ratios of superplasticizer and water reduction at 3 days of age	41
(4-15)	Results of compressive strength developed using different ratios of superplasticizer and water reduction at 7 days of age	43
(4-16)	Results of compressive strength developed using different ratios of superplasticizer and water reduction at 28 days of age	45
(4-17)	Compressive strength developed for concrete mixes using superplasticizer ratios of (0.4 - 0.8 - 1.2 -1.5) L per 50 kg cement and (10%, 15%, 20% and 30%) water reduction	47
(4-18)	Results of compressive strength developed using different ratios of superplasticizer and (water & cement) reduction at 3 days of age	48
(4-19)	Results of compressive strength developed using different ratios of superplasticizer and (water & cement) reduction at 7 days of age	50
(4-20)	Results of compressive strength developed using different ratios of superplasticizer and (water & cement) reduction at 28 days of age	52
(4-21)	Compressive strength of concrete mixes developed by using Super plasticizer ratios of (0.0, 0.4 and 0.8) Litre per 50kg of cement, water reduction of (10% and 15%) and cement	54

	reduction of (10% and 15%)	
(4-22)	Results of absorption after 28 days: control mix	56
(4-23)	Result of absorption after 28 days: (superplasticizer ratio = 0.4L per 50kg of cement) and 10% water reduction	57
(4-24)	Result of absorption after 28 days: (superplasticizer ratio = 0.8L per 50kg of cement) and 15% water reduction	57
(4-25)	Result of absorption after 28 days: (superplasticizer ratio = 1.2L per 50kg of cement) and 20% water reduction	58
(4-26)	Result of absorption after 28 days: (superplasticizer ratio = 1.5L per 50kg of cement) and 30% water reduction	58
(4-27)	Result of absorption after 28 days: (super plasticizer ratio = 0.4L per 50kg of cement), 10% water reduction and 10% cement reduction	59
(4-28)	Result of absorption after 28 days: (super plasticizer ratio = 0.8L per 50kg of cement), 15% water reduction and 15% cement reduction	59
(4-29)	Effect of superplasticizer ratios on absorption of concrete mixes for 28 days of age	60
(4-30)	Effect of (0.4 and 0.8) L per 50kg of cement superplasticizer, (10% and 15%) water reduction and (10% and 15%) cement reduction on absorption of concrete mixes for 28 days of age.	61

List of Figures

Figure No	TITLE	Page
(3-1)	The effect of a water reducing admixture on the dispersion of cement particles	16
(3-2)	Flocculating cement particles trapping the mix water	16
(4-1)	Grain Size of coarse aggregate test	28
(4-2)	Grain Size of fine aggregate test	29
(4-3)	Relationship between Results of Slumps and Superplasticizer ratios and water reduction	31
(4-4)	Relationship between Results of Slumps and Superplasticizer ratios and (water & cement) reduction	32
(4-5)	Relationship between compressive strength developed and different ratios of superplasticizer and water reduction at 3 days of age	42
(4-6)	Relationship between compressive strength developed and different ratios of superplasticizer and water reduction at 7 days of age	44
(4-7)	Relationship between compressive strength developed and different ratios of superplasticizer and water reduction at 28 days of age	46
(4-8)	Compressive strength of concrete mixes developed by using different ratios of superplasticizer and water reduction	47
(4-9)	Relationship between compressive strength developed and different ratios of superplasticizer and (water	49

	&cement)reduction at 3 days of age	
(4-10)	Relationship between compressive strength developed and different ratios of superplasticizer and (water &cement)reduction at 7 days of age	51
(4-11)	Relationship between compressive strength developed and different ratios of superplasticizer and (water &cement)reduction at 28 days of age	53
(4-12)	Compressive strength of concrete mixes developed by using Super plasticizer ratios of (0.0, 0.4 and 0.8) Litre per 50 kg of cement, water reduction of (10% and 15%) and cement reduction of (10% and 15%)	54
(4-13)	Compressive strength of concrete mixes developed by using Super plasticizer ratios of (0.0, 0.4 and 0.8) Litre per 50 kg of cement, water reduction of (10% and 15%) and cement reduction of (10% and 15%)	55
(4-14)	Relationship between superplasticizer ratios and absorption of concrete mixes for 28 days of age.	60
(4-15)	Absorption concrete mixes after 28 days: superplasticizer (0.4 and 0.8)L per 50kg of cement, (10% and 15%) water reduction and (10% and 15%) cement reduction	61