Full Texts & Abstracts of SERES'18

Editors
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seres'18

IV. INTERNATIONAL CERAMIC, GLASS, PORCELAIN, ENAMEL, GLAZE AND PIGMENT CONGRESS

October 10-12, 2018
Anadolu University
Eskisehir Technical University
Eskisehir / Turkey

Turkish Ceramic Society

ANADOLU UNIVERSITY

ESKİŞEHİR TECHNICAL UNIVERSITY

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FULL TEXT OF POSTER PRESENTATIONS

SERES'2018 Brings Ceramic People Together in Eskisehir

With the assistance of Anadolu University, Turkish Ceramic Society (TSD) organizes **SERES'18 "IV. International Ceramic, Glass, Porcelain Enamel, Glaze and Pigment Congress"** which aims to bring academicians, artists, designers in the fields of ceramic, glass, porcelain enamel, glaze, pigment and cement, and people of regarded industries together, supplying them suitable arena for sharing knowledge and experiences and for determining possible future collaborations with its wide range of coverage. SERES'18 will be held on the **10 - 12 October 2018** in Anadolu University, Yunusemre Campus Congress Centre and in Eskisehir Technical University, Iki Eylul Campus Eskişehir/Turkey.

As you know, congresses are not only the activities anymore where scientists gather together and foster the recent advances in art, science and industry but they have also become the organizations where the culture and values of their location are appreciated. Accordingly, a rich social program waits for you so that you can enjoy the unique artistic and cultural features of Eskişehir.

On behalf of the organizing committee, it is my pleasure for me to invite you to participate in this exciting meeting.

I look forward to seeing you in October in Eskişehir.

Best Regards,

On behalf of Organising Committee
Prof. Dr. Alpagut KARA (Chairman)

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TSF: Turkish Ceramic Federation
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IV.INTERNATIONAL CERAMIC GLASS PORCELAIN
ENAMEL GLAZE AND PIGMENT CONGRESS
October 10-12, 2018, Eskisehir, Turkey

Full Text of
INVITED SPEAKERS

CEMENT, CONCRETE AND JEOPOLYMERS

ASSESSMENT OF MECHANICAL PROPERTIES IN PORTLAND CEMENT BY OPTICAL MICROSCOPY AND NUMERICAL COLOR ANALYSIS

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Cement industry has an production output of clinker which directly affects the quality of cement. Different raw materials preferred and furnace conditions followed have an essential impact on clinker and cement characteristics. Therefore, determination of phase occurrences, sintering behavior and porosity aspects are sensitively followed so as to achieve high quality clinker as well as cement. However, controlling and confirmation of final product parameters take very long times. In this study, it is aimed to assess the mechanical properties of ordinary Portland cement (OPC) by performing optical microscopy measurement and numerical color analysis. For that purpose, two types of cement samples (CEM I 42,5R and CEM I 52,5N) were taken from a company in Afyonkarahisar/Turkey. Uniaxially pressing was performed to moisturised cement samples in order to have flat surface, and then pressed samples were sticked to lamelleas and made thin sections to get visible and smooth surface for optical microscopy measurement. The images taken from optical microscopy were analyzed via MATLAB software to obtain color distributions in terms of RGB (red-green-blue) values. It was observed that consistent results regarding cement type was determined and these consequences were also verified with production datas, particularly mechanical properties. It was found that as blue color value increase the mechanical properties of cement is improved.

Key words: cement, clinker, color, numerical analysis

1. Introduction

Cement production, as one of the most energy consuming industry, takes great importance for building, construction and transportation [1]. Among the cement classes produced including aluminate cement, white cement, etc., ordinary Portland cement is commonly preferred class reaching up to 90% among others around the world. Portland cement is mainly composed of clinker, gypsum and/or fly ashes which depends on the target application area in terms of constituents and amounts [2]. The clinker is produced by mixing clay and lime stone raw materials in the appropriate amounts and fired up to nearly 1500 °C so as to achieve compositionally stable clinker phases and morphologically homogeneous powder at the end of the process [3]. Since the clinker has a significant role on the characteristics of cement as well as concrete it is so crucial to control the properties of clinker during process conditions. Therefore, phase occurrences, sintering behavior and porosity aspects are sensitively followed in order to obtain high quality clinker as well as cement [4].

In the clinker, it has been identified more than thirty phases occurred, however just four phases, that are listed in Table.1 are carefully focused on [3]. All these phases have different crystal structures, meaning that different properties can be encountered. That is to say, alite ensures short term resistance whereas belite provides long term resistance to the end product. On the other hand, aluminate and ferrite have a reasonable impacts on resistance of cement [5].

Table 1. Main phases, chemical formulas and abbreviation of clinker phases.

Name	Chemical Formula	Abbreviation
Tricalcium silicate (alite)	$3CaO.SiO_2$	C_3S
Dicalcium silicate (belite)	$2CaO.SiO_2$	C_2S
Tricalcium aluminate (aluminate)	$3CaO.Al_2O_3$	C_3A
Tetracalcium ferroaluminate (ferrite)	$4CaO.Al_2O_3.Fe_2O_3$	C_4AF

From the viewpoint of production plants, controlling and confirmation of all these different process parameters during production stage take very long times. To support with an example, preparation of samples for variety of measurements in accordance with TS EN 197-1, TS En 196 series and so on are so cumbersome that both number of samples prepared periodically and person in charge in every working shifts are extra cost for production plants. To overcome timing trouble as well as cost aspects, faster and reliable methodologies would be preferred and numerical color analysis is one of those, especially digital image processing has increasingly been performed in many areas including aerospace, defence, medical diagnosis, etc [6]. Not only fast response can be taken but also non-destructive experiments can be carried out along with process conditions in production plants.

In the field of image based analysis, color concentrations and their distributions in the intended region of samples are of interest. Color is defined as an interaction between matter and light. The physics of light, the chemistry of matter and object geometry as well as visual perception of human are the primary parameters of color occurred. For determination of color assortment, several models

including RGB, HSV, L'a'b' can be utilized [7]. In this study, Matlab software is preferred for numerical color analysis and RGB values are found out thanks to the digital image processing calculations. It is observed that consistent results regarding cement classes can be assigned and these consequences can also be verified with production experiment results, particularly mechanical properties.

2. Experimental Data

Two different classes of ordinary Portland cement were obtained from Afyon Cimento Inc. located near to Afyonkarahisar provinence. The cement classes and related chemical compositions are listed in Table 2. The obtained CEM I 42,5R and CEM I 52,5N types of OPCs were firstly uniaxially pressed using vacuum pressing machine by applying 2000 kg/cm^2 pressure, and thus two samples for each classes, totally four circular shaped samples with flat surfaces, were achieved. The pressed samples were then sticked onto lamealleas and grinding operation with sandpapers were carried out until light transmission from samples was apparent. In addition to sandpaper grinding, silicon carbide abrasive powders was used so as to obtain smoother surface, as well. The prepared samples can be seen in Fig.1. Sample numbers of 1 and 2 relates to the class of CEM I 42,5R while 3 and 4 numbers refers to CEM I 52,5N class.

Table 2. Chemical compositions of OPC samples.

Constituent	CEM I 42,5R	CEM I 52,5N
LOI	3,78	2,15
SiO_2	18,83	19,85
Al_2O_3	5,14	5,07
Fe_2O_3	2,65	3,02
CaO	63,01	64,65
MgO	2,05	1,79
SO_3	2,91	2,95
Na_2O	0,34	0,12
K_2O	0,88	0,38
Cl^-	0,0099	0,0071
Insoluble HCl	0,38	0,19

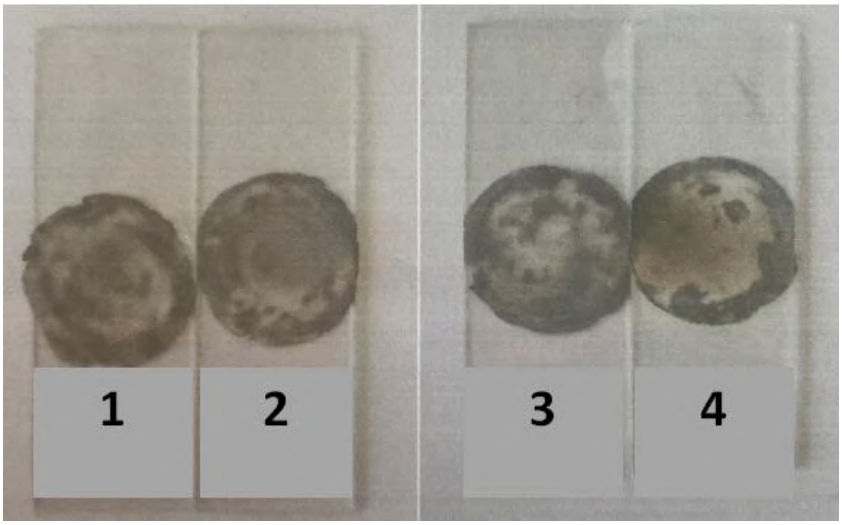

Fig.1 Grinded cement samples (1, 2 : CEMI 42,5R and 3,4 : CEMI 52,5N).

As flat and smooth sample surfaces were obvious optical microscopy measurement with Olympus BX51M was performed in order to take surface images. The optical microscopy images are revealed in Fig.2. The magnification of 50x was applied for each samples independently. The images taken from optical microscopy were analyzed via Matlab software to obtain color calculations in terms of RGB (red-green-blue) values. The results of image processing and mechanical properties of OPC classes are presented in the upcoming section.

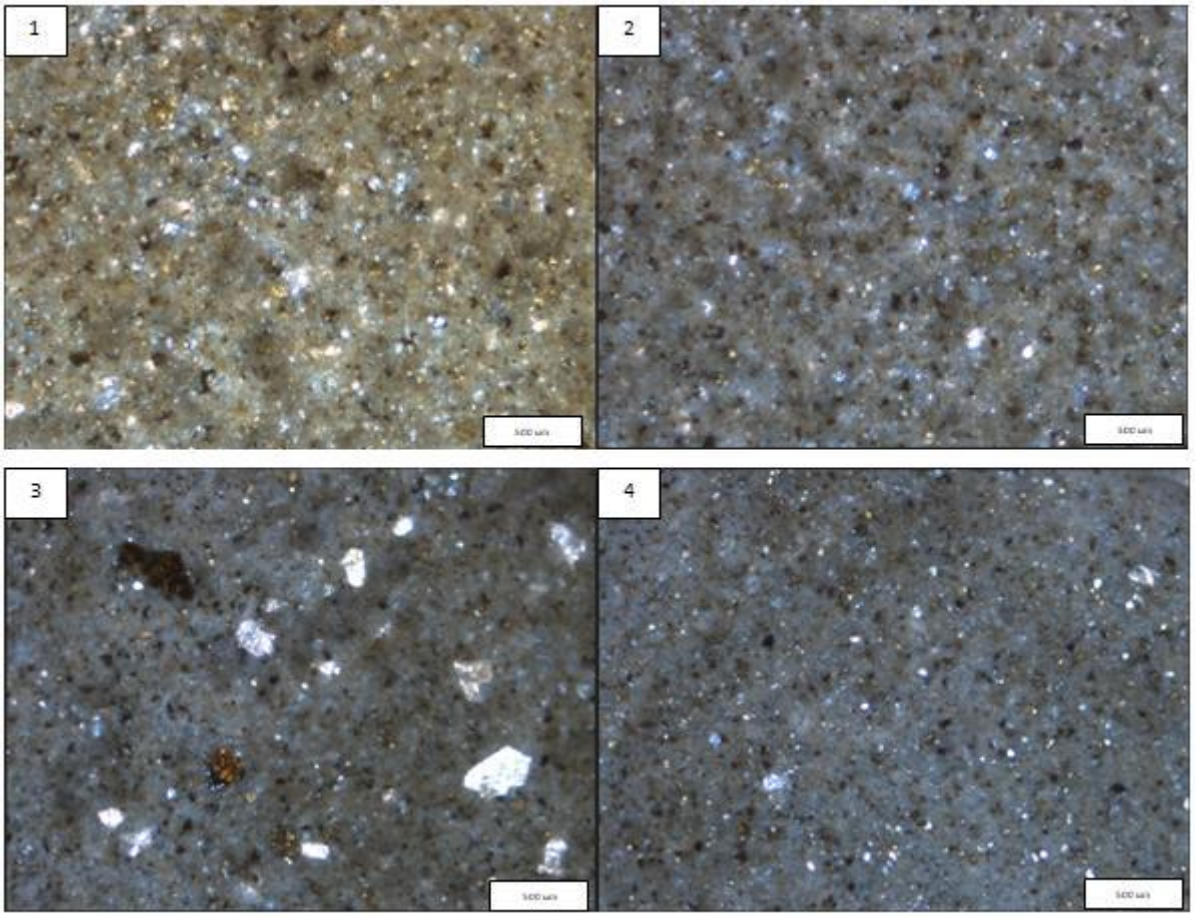

Fig. 2 Optical microscopy images of cement samples (1, 2 : CEMI 42,5R and 3,4 : CEMI 52,5N).

3. Results and Discussion

Two different classes of cement samples were analyzed via Matlab software in order to calculate RGB values after sample preparation and taking optical microscopy images and the results are given in Table.3. As can be seen from B-values in Table.3, it begins to increases as cement class changes, particularly it is important to focus on 1 and 4. Sample number of 1 describes CEM I 42,5R cement classes whereas number 2 states CEM I 52,5N.

Table 3. RGB values related to the cement samples.

Sample No.	R	G	B
1	24,9	4,7	5,4
2	13,0	8,3	46,3
3	8,5	9,4	51,7
4	2,8	6,4	78,0

Further, illustration of the values given in Table.2 can be seen in Fig.3. Thanks to the RGB color space illustration, it can be obviously observed that the coordinates of color shifts to dark blue

region, especially it is very sharp between 1 and 4. It is essential to emphasize that there are small differences in blue values between 1 and 2, and 3 and 4 although they represent the same cement class. This small changes can be assumed as tolerance values, in any way.

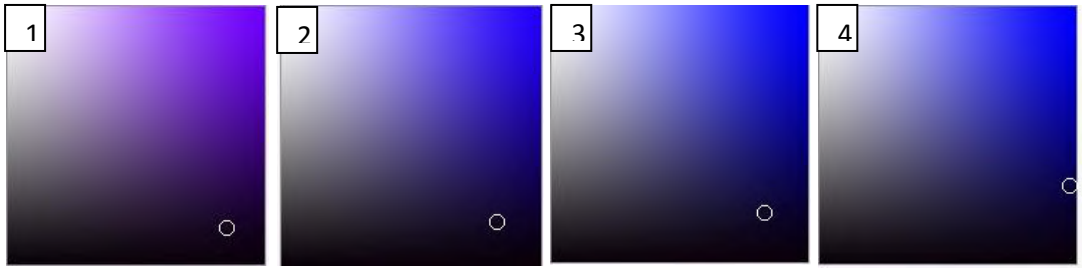

Fig. 3 Illustration of RGB values in RGB color space [8].

When it comes to analyze the production experiment results of cement classes, it is clearly revealed in Table 4. Compressive strength values upon 2, 7 and 28 days waiting periods for cement classes can be seen. As the waiting period increases, compressive strength values increase for both classes of cement materials. However, CEM I 52,5N class of cement has higher compressive strength values compared to CEM I 42,5R in different days.

Table 4 Production datas for compressive strength of cement classes.

Cement Type	Compressive Strength (2 days)	Compressive Strength (7 days)	Compressive Strength (28 days)
	N/mm^2	N/mm^2	N/mm^2
CEM I 42,5R	31,6	44,6	55,4
CEM I 52,5N	35,6	51,0	65,3

4. Conclusions

In this study, we propose a faster and reliable methodology by using optical microscopy imaging followed by numerical color analysis for assessment of mechanical properties in ordinary Portland cement rather than performing time consuming measurements. It was observed that consistent results regarding cement class can be assessed and these consequences were also verified with production datas, particularly mechanical properties. It was found that as blue color value increase in RGB calculations the compressive strength of cement will increase. In this sense, this study is just for the begininng to assess the mechanical properties without experimental efforts and these assessments can be improved by increasing the number of samples analyzed. Besides that, a database

can be created by accumulating the assessment results which can later on allows to create a software capable of soft computition.

5. Acknowledments

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