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Electroencephalogram Signals Analysis: A Study

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ABSTRACT

Electroencephalography (EEG) is a process of extracting accurate information from the brain using electrodes attached to the scalp. In the area of biomedical signal processing, EEG signal has developed importance in the diagnosis, and treatment of abnormalities and brain diseases. It has revealed massive facilities to advance human life. In this paper, a state of art on EEG signal analysis is presented that aims to cover various signal processing and machine learning techniques to recognize the mental health conditions of the human being thereby paving a way to assist medical professionals, besides revealing future opportunities and scope available in this research domain.

Key-words: - Electroencephalogram signals, Feature Extraction, Signal Processing.

I. INTRODUCTION

The human brain is an incredible part of the human body. The most complex part of our body is the brain. It consists of approximately a hundred billion neurons, interconnected via axons and neurons. Through synapses, the neurons receive stimulus which travels through the axon as electrical impulse helps control emotions, body movements, and other aspects of the body [1]. The electrical activities of the brain are detected by EEG signals. EEG signals have a very important role in clinical and research purposes. The fluctuating electric potential of the brain can be recorded by electroencephalography [2]. This potential electrical occurs by placing electrodes on the scalp and applying gel on it. The brain's activity reflects the EEG signal recorded by fixing the electrodes on the scalp. During the recording of the brain waves, it results in a high-resolution sequence within a short time. Epilepsy is primarily treated with EEG. The conditions that result in abnormalities of EEG data like coma, anesthesia, brain death, a disorder in sleep, etc. are treated using EEG. The brain-computer interference (BCI) is a mechanism that enables brain impulses to communicate within the globe. EEG is a treatment process for strokes, tumors, and other localized brain illnesses. In the BCI system, there are lots of options to determine brain pulses like EEG, MEG, MRI, ECoG, LPF, etc. In the market, we can get numerous electrode channels like 14 electrodes, 64 electrodes, 128 electrodes, etc. The most consistent and regularly used is the BCI system. The range of frequency in which the EEG pulses are recorded is for delta the range is between 0.5-4.0 Hz, for theta the range is 4.0-8.0 Hz, for alpha the range is 8.0-13.0 Hz, and beta is less than 13.0 Hz. Placing 10 to 20 electrodes on the scalp of the brain the EEG pulses are determined. EEG has become the most efficient method of detecting brain pulses [3].

1.1 Brain-Computer Interference System (BCI)

A (BCI) method is mainly of 4 phases. Signal Acquisition, Signal Pre-Processing, Feature Extraction, and Classification are the stages of BCI. The brain pulse is connected to the outside world with the help of a Brain-Computer Interface (BCI). Invasive and non invasive are two techniques used in the BCI system. Bio-medical, robotics, surgery, etc. can get lots of benefits from it [4].

1.2 Signal acquisition of the brain

Some of the approaches assess the variance of electrical activities connected to different states of the brain, while others measure a variety of other characteristics. Non-invasive and invasive acquisition methods are two types of techniques. Intra-cortical electrode arrays and electrocorticography (ECoG, intracranial) are two types of invasive procedures. EEG, near-infrared spectroscopy (NIRS), functional magnetic resonance imaging (fMRI), positron emission tomography (PET), and magnetoencephalography (MEG) are the noninvasive methods [5].

1.3 Signal Preprocessing

At signal preprocessing of BCI, EEG filtering is done [4]. There are numerous approaches that are designed to remove the noise generated by a variety of skills from the EEG pulses. The major plan of this method is to generate a new set of resulting channels that enhance the separability of the data. Preprocessing of the signal includes the instruction of the EEG reports. Filtering, segmentation, and detrending were utilized to set up the EEG data for the next stages. Filtering and segmentation which is also named epoching are the methods of recognizing and exploiting data above a definite frequency or time array which is connected through the feature of brain action. After filtering is done the segmentation of EEG information is performed. After the processing method, the next step is to simplify the extraction of features and classifications process.

1.4 Feature Extraction

Feature extraction is a method by which applicable information from the raw data is extracted for further classification purposes [6]. The applicable information extracted is not required to be in the form of raw data. Feature extraction includes extracting the applicable data from the digitized data with which proper classification can be done. The extraction of features is the largest part of a significant element of any classified process. The extraction of features includes biased information hence the accuracy of feature extraction affects classification accuracy. Extraction of features can be done in both frequency and time domains. Some examples of time domain analysis are common spatial patterns, autoregressive parameter estimation, and basic probability and statistical analysis. Some examples of frequency domain analysis are Fourier spectrum analysis and power spectral density estimation. Data reduction can also be achieved in the feature extraction process as only the relevant data is selected for classification purposes and thus reducing the processing time. There are many methods of feature extraction. (AR)Autoregression, (CSP)Common spatial pattern, (DWT) Discrete wavelet transform, (PWD)Power spectral density is the technique of extraction.

1.5 Classification

Classification is an important state of Brain-computer interference [7]. After the signal is extracted from the feature the signal processing is then classified by the various classifier. The classifiers are easy to use. It gives good results. There are different types of classifiers. The main aim of classification is to convert neural data to control logical signals. A few classifiers can be listed as (LDA)Linear Discriminant Analysis, (QDA)Quadratic Discriminant Analysis, (LSM)Linear support vector, and (KNN)k- nearest neighbor.

2. Related work

Asieh Ahani (2013), study investigate that “mind-fullness meditation (MM), an inner psychological implementation is practiced through which a response relaxes but the state of mindset is nourished in [7]. To check the high-stress level also, MM carry out the highstress level of the number of older people. Their study estimates the gesture methodologies of EEG. MM action was carried out for a growth sign through meditation and control conditions to support the quantification of the meditative remark. Collected data of respiration and EEG were analyzed six weeks later meditation intervention on 34 novice meditators. Analyzed collected data with spectral analysis to assess a goal mark for meditation with the support vector machine classification. In their study, they notice control condition and meditation differences in beta, alpha, and theta frequency bands. The result concludes that analysis of EEG spectral revealed a generalized increase in beta, and during meditation, theta

EEG power compared to control. In the posterior and right lateral location, the increase of alpha EEG power during meditation compared to control.

Shih-Feng (2011) Along with his fellow researchers studied time-frequency analysis which is important and analytic tools are used for evaluating physiologic signals [8]. Their study was designed to detect the sampling frequency of 250 Hz during meditation through characterized of EEG recorded with 19 active electrodes. And through this study an acquired of new insights is obtained into the nature of EEG during meditation by the performed analyzed tools which records signal done by Fast Fourier Transform (FFT). Efficient segmentation in EEG signal processing is an important problem. At different electrodes exhibit behavior, the comparison between the recording time is strongly dependent on frequency and time.

Min Huang (2019) study investigates the meditation differences in between walking and sitting [9]. Identification of these four states is extracted and calibrated using the Rhythm feature, and these states are performed by the EEG signal of 7-day Zen participants. The performance of calibrated features with that of original features is compared. Their study classifies the accuracy of the proposed calibration methods is significantly improved. Vichivt Boonyahotra (2017) has aspired their study to probe and recognize inner wisdom training and meditation [10]. In their study, six healthy participants measured between 20-40 years of age were applied for EEG power spectra. All nine experiments were done equally to all the participants. While the EEG records the movement when the participants are urged to close their eyes for 3 minutes. During the observance activities of brainwave were recorded individually by EEG at one and three after the experiment began. The study conclude that inner wisdom meditation had accomplished on alpha, theta, and gamma frequency bands. Muhammad Zeeshan et.al. (2014) in their paper based on EEG signals have developed an effective way to classify the EEG signals [11]. The EEG signals were carried out on 2 electrodes c3 and c4. They have given a qualified revision on classification with a new advanced system. They used a self-organization map (MOP) based neural technique. For feature reduction principal component analysis has been worn. To categorize motor imagery EEG pulse, they have found the best approach by unsupervised and supervised features for an algorithm. SOM has been the best approach for EEG sourced BCI devices. By using advanced processing signal techniques different diagnoses can be extracted from different feature diseases. Effects of different EEG signals events and hidden data from signals are used to extract from the processing signal method are examined. Frequency domain, time-frequency, linear and non-linear techniques like Hurst exponent(H), largest Lyapunov exponent (LLE), correlation dimension (CD), fractal dimension (FD), different entropies, higher order spectra (HOS). Using a classic normal EEG signal is discussed in recurrence plots and phase space in detail [12]. Akshaya R. Mane and his team (2015) compares different extraction of feature technique such as (ICA)Independent component Analysis, (WT)Wavelet Transform, (PCA)Principal component analysis, (AR)Autoregressive model, (EMD)Empirical mode decomposition. They have studied the significant measurement and distinguishing properties from different methodologies. They have concluded that high-quality performance does not obtain in the frequency domain method in EEG signal also time- frequency does not provide as much information as the frequency domain does. Hence, they suggested choosing the technique according to the mental task to get better performance [13].

Wan Amirah W.Azlan and his team (2008) says that an appropriate system for the extraction of feature is required to achieve the best results. Though there is various technique they have chosen the feature which is the majority used for schizophrenia. Hilbert-Huang transform, Principal Component Analysis, Independent component analysis, Local Discriminant Base are the techniques used in their resource. They have concluded that all the techniques are capable to distinguish the organized and alcoholic groups. They said that LDB is very effective to extract features [14].

Chamila Dissanayaka [2014] and his team investigated the difference between a brain region and human (drowsiness, meditation, and awake) states by comparing coupling (also known as information flow) and coherence (also known as connectedness) accomplished in the study. Through each condition different region of information was estimated to measure the brain's flow or the coupling by a method known as The Directed Transfer Function (DTF). To measure the connectedness or coherence between brain area a method known as Welch and Minimum Variance Distortion-less Response (MVDR) were used. Analysis was conducted of 30 subjects comprising 10 meditating, 10 awake, and 10 drowsiness with six electrodes utilizing the EEG data. For individual subjects, five minutes of baseline and 15 minutes of exact condition comprising meditation, consciousness, and tiredness EEG data were recorded. Data analysis was moved out which consist of Kruskal Wallis 9KW nonparametric examination of variance occurred Bonferroni alpha-correction by a post-hoc test. The outcome result of the study concludes that the spectral summary of the brain's coupling (or information flows) as well as its coherence (or connectedness) that change in surface awareness led to substantial difference [16].

U. Rajendra Acharya's (2018) research about Brain disorder disease in humans known as Epilepsy can affect anyone at random age. People suffer from Epilepsy nearly 50 million globally. Seizures are observed because of excessive discharge of electrical in brain cells. Focal(F) and non-focal (NF) types of Electroencephalogram (EEG) carry activity of brain information that estimates to identify affected areas by seizures. Generally, the Epileptic area of the brain is recorded by FEEG signals while unaffected Epileptic from brain regions is recorded by NFEEG signals. Correct detection is important to detect FEEG signals, they occur when and where as successful treatment of focal epilepsy can be treated by the surgical process. Also, highly trained personnel are required as all EEG signals are complex for the right explanation. To associate with the overcome challenge, a computer aided detection (CAD) system to assist the FEEG signals of detection has developed and the presentation of nonlinear features in EEG signals containing Rhythms and concealed patterns can capture effectively. All-inclusive, this study constructs that the CAD system will benefit in providing clinicians with an accurate and objective paradigm for the localization of the Epileptogenic area [17].

Table 1: Brainwave Classification [18]

Wave	Frequency	Mental state
Gamma	40Hz or more	High level of order processing
Beta	13 to 40Hz	Normal walking consciousness
Alpha	8 to 12Hz	Woke up but relaxed
Theta	4 to 7Hz	Less sleep or extreme relaxation
Delta	> 4Hz	Depth dreamless sleep

EEG is a test that reads the electrical impulses of the brain by using numerous electrodes which transfer information from the brain to a machine that measures and records the data.

3. Mathematical Tools and Techniques

3.1 Discrete Wavelet Transform (DWT)

Wavelet Transform (WT) is a key function in the diagnostic field and recognition. WT reduces the time-varying in bio-medical signal, which consists of a lot of information points into a modest parameter that presents the pulses [19]. Because the EEG pulse is not constant, using a time-frequency domain technique such as the wavelet transform (WT), which is a spectral approximation approach in which various common functions may be described as an infinite series of wavelets, is a good way to extract features from raw data.

The unique EEG signal is represented in the WT approach by wavelets, which are protected and simple building units. During dilation and translation, the wavelet generates these wavelets as part of derived functions, shifting actions adjacent to the time axis. Wavelet Transforms are divided into two types: continuous and discrete.

$$\psi_{a,b}(t) = \frac{1}{\sqrt{a}} \psi\left(\frac{t-b}{a}\right) \tag{1.1}$$

Here,

$H(z)$ shows the filter's h z-transformation. The (HP) high pass filter's matching z-transformation is expressed as

$$H(z) = \frac{z^2 - 1}{z^2 + 1} \tag{1.2}$$

There are a number of benefits to precisely relating the character of the signal section inside a particular frequency range and enclosed time domain qualities, which offset the high computational and recollection necessities of the predictable convolution-based DWT completion.

3.2 Autoregressive Method

The estimation of (PSD) power spectral density of EEG with various parametric approaches is done by a technique called the autoregressive method [20]. So, it does not have any issue with spectral leakage and gives a good result in frequency. By calculating the coefficient, we can get the estimation of power spectral density. Two technique of the autoregressive method is discussed below [20][21]:

3.3 Yule-Walker technique

Using Yule- walker process the PSD is estimated. The calculation method is specified below

$$r_{xx}(k) = \frac{1}{N-k} \sum_{n=0}^{N-k} x(n)x(n+k) \tag{1.3}$$

r_{xx} is expressed by

$$r_{xx}(k) = \frac{1}{N-k} \sum_{n=0}^{N-k} x(n)x(n+k) \tag{1.4}$$

calculation on top of set of $(p + 1)$, the coefficients of are is as follow:

$$P_{xx}(f) = \frac{\sigma^2}{1 + \sum_{k=1}^p a_k e^{-j2\pi f k}} \tag{1.5}$$

$$a_k = \frac{r_{xx}(k) - \sum_{l=1}^{k-1} a_l r_{xx}(k-l)}{r_{xx}(0) - \sum_{l=1}^{k-1} a_l r_{xx}(l)} \tag{1.6}$$

3.4 Burg's technique

The reflection coefficient is straight forwardly calculated without the autocorrelation technique. To satisfy Levison-Durbin recursion the backward and forward prediction error is reduced based on AR methods. The method is as follows:

$$P_{xx}(f) = \frac{\sigma^2}{1 + \sum_{k=1}^p a_k e^{-j2\pi f k}} \tag{1.7}$$

Burg's method gives exact data value. It produces well packets which are sinusoid once it holds minimum level of noise. The Burg's method and Yule's- method is calculated in different process. The autoregressive method estimated good frequency resolution and spectral leakage.

3.5 Common Spatial Pattern (CSP)

This strategy of CSP is first introduced by Ramsor to classify motor imagery. The spatial resolution of EEG is improved by CSP algorithm. The abnormality of EEG activity is detected by CSP [23]. In movement related pattern CSP has become the effective method. In BCI signal processing it has become the most effective method. It is a mathematical expression to obtain optimal spatial filtering by decomposing unprocessed EEG signals. Though it is an effective method in acquiring EEG signals it has many disadvantages and limitation. The mathematical expressions are shown below:

$C_1 = \frac{(X_1 X_1^T)}{\text{Trace}(X_1 X_1^T)}$	(1.8)
$C_2 = \frac{(X_2 X_2^T)}{\text{Trace}(X_2 X_2^T)}$	(1.9)

The equation of covariance matrix together are expressed as:

$C = \frac{1}{2} (C_1 + C_2)$	(2)
-------------------------------	-----

U_0 = eigenvectors

Σ = The covariance matrix C has a diagonal matrix of eigen values.

$$= \sum_{p=1}^P U_p \lambda_p U_p^T$$

Then, a conversion (P) is applied to the average covariance matrices for both classes as Eq.

$S_1 = P C_1 P^T$	(2.1)
$S_2 = P C_2 P^T$	(2.2)

S_1 and S_2 contain the similar eigenvectors, and the mixture of the related eigen values for both are equal to one. It can be expressed as:

$S_1 = U \Sigma U^T$	(2.3)
$S_2 = U \Sigma U^T$	(2.4)
$\Sigma_1 + \Sigma_2 = I$	(2.5)

S_1 have the maximum value of eigen vector, S_2 have the least value of eigen vector

$W = [U_1 \dots U_p]$	(2.6)
-----------------------	-------

The independent component off EEG data is:

$Y = WX$	(2.7)
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The process of common spatial patterns (CSP) designs spatial filters to obtain variances in the filtered time sequence information are finest for discrimination.

The main aim of CSP is to discover M spatial filters, it linearly changes the input signals by following equation:

$y = W^T x$	(2.8)
-------------	-------

where $s(t)$ = vector of input signals at time t from all the channels:

$$s(t) = \begin{bmatrix} s_1(t) \\ s_2(t) \\ \vdots \\ s_n(t) \end{bmatrix} \quad (2.9)$$

A matrix W is determined in CSP technique:

$W^T X W = I$	(3)
$W^T X W = I$	(3.1)

3.6 Power Spectral Density (PSD)

PSD is one of the techniques used for feature extraction process. PSD is used in narrow band signal and in signal processing. PSD distributes the power signal over frequency as role of frequency it shows the energy of power[22].

$$P(f) = \lim_{T \rightarrow \infty} \frac{1}{T} \int_{-T/2}^{T/2} |x(t)|^2 e^{-j2\pi f t} dt \quad (3.2)$$

3.7 Bagging Classifier

Decisions in use from diverse learners be able to joint into single forecast. Simply combining individual decision in an organization's folder is voting. This method is used for boosting and bagging[24]. Individual models are bagged and boosted in a variety of ways. Models in bagging are given the same weights, but adding successful models in boosting are given greater weighting, as an executive may base his or her decisions on a variety of experts' suggestions.

Algorithm 1

Bagging algorithm 1

Input : data $D = \{(x_1, y_1), (x_2, y_2), \dots, (x_m, y_m)\}$

Learning of base algorithm f

Number based learners L

method:

- 1) $t = 1, \dots, L$
- 2) I_t distribution of bootstrap
- 3) **End**

Bagging Output: $H(x) = \text{Majority} \left(\sum_{t=1}^L h_t(x) \right)$

3.8 Boosting Classifier

Boosting is a process in which a strong classifier is created with the weaker ones. It is an algorithm of a machine learning. In machine learning boosting helps in removing the conflicts and unfairness. The boosting was used to combine a large number of models in order to build this concept by attempting to find models that complement each other

ALGORITHM

Input of sample distribution D

Learning of Base algorithm f ;

Number based learners L .

PROCESS:

- 1) $D_t = D$. % Initialized distributor
- 2) $t = 1, \dots, L$
- 3) $h_t = \text{Train}(D_t)$ % Trained a weaker learner for distributed D_t
- 4) $E_t = \text{Error}(h_t)$; % Evaluate the error h_t
- 5) $D_{t+1} = \text{Adjusted_Distribution}(D_t, E_t)$
- 6) *End*
- 7) BOOSTING OUTPUT: $H(x) = \text{combined_outputs}(\{h_t\})$

Conclusion

This study presents a general idea on EEG signal analysis for wellbeing assessment using various signal processing and machine learning techniques. It spans a detailed study on various signal processing techniques for feature extraction followed by the classifications of EEG signals for abnormality detection. The EEG analysis proves instrumental to know the mental condition of the human being including detection of the left handedness and right handedness of persons. In spite of challenges present in the EEG signals analysis mainly due to its non-linearity, non-stationary, low amplitude and low frequency characteristics, still there is a tremendous scope to implement recent signal processing and machine learning tools for proper analysis of EEG signals to extract the clinical information at early stage and help the neurologists.

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Effect of addition of silicafume and different fiberes on the behavior of sulfate infected BC soil

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ABSTRACT

The stress resistant properties of soils can be improved in a variety of ways. For example, sheets, strips or rods of metal or polymeric materials can be placed in the soil to create a composite material. Researchers believe that there is a great potential of combined usage of monofibres and hybrid fibers as a stabilization materials in sulphate infected black cotton soil mix, making it stronger and durable. But not much progress has been made in this regard. The main objective of this research work is to investigate the index properties and stress resistant properties by adding stabilization materials like, silicafume along with monofibres and hybrid fibres. The research is proposed to address the following problems. 1. Effect of replacement of sulphate infected BC soil by stabilization material such as Silicafume (SF) in different percentages like 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35% and 40% and thereby determining the optimum dosage of stabilization materials. 2. Effect of addition of different monofibres such as Jute fibre (JF), Poly propylene fibre (PPF), Waste plastic fibre (WPF) and High density polyethelene fibre (HDPEF) on the properties of sulphate infected BC soils. 3. Effect of addition of different hybrid fibres such as (JF+WPF), (PPF+WPF) and (PPF+HDPEF) on the properties of sulphate infected BC soils. It is observed that the sulphate infected black cotton soil using silicafume as stabilization material has shown improved index properties at 20% replacement level. Unsoaked CBR value, soaked CBR value, cohesion value from direct shear test and UCC test cohesion value, all show an increasing trend upto 20% replacement of black cotton soil by silicafume. After 20% replacement level, all the above values go on decreasing. It is observed that the sulphate infected black cotton soil using silicafume as stabilization material along with monofibres has shown improved stress resistance properties when monofibres are added at 1.5% by volume fraction. From the results obtained, it may also be concluded that, the performance of HDPE fibres is better than polypropylene fibres, waste plastic fibres and jute fibres in enhancing the stress resistance properties of sulphate infected black cotton soil using silicafume as stabilization material.

Key-words: - Silicafume; Polypropylene fiberes; Sulfate infected BC soil; Stabilization; Stress resistant

I. INTRODUCTION

Good quality soil is always essential for the construction of any civil engineering infrastructures. This is even true for roads and highways. Good quality sub-grade soils are necessary for durable roads. Sometimes such soils may not be available and the construction engineer or highway engineer is likely to face problem in the design and constructions. The sulphate infected black cotton soil exhibits low load bearing capacity and high swelling property and this may pose many problems on site. Volume changes of some soils resulting from changes in their water content may cause unappreciable movement of structure that are founded on such soils, resulting in heaving, shear failure, accessible settlement, cracking and breaking up. Among the problems of soils, the soil infected with sulphates pose peculiar

problems on site. Unless the problems of sulphate bearing soils are not addressed properly, the durability of the structure will be in question. The sulphate attack on soil is usually accompanied by strength loss and large volume changes resulting in substantial heave in stabilized earth works. Many researchers have reported examples of detrimental effect of sulphate either naturally present in the ground or artificially added. Among the most commonly encountered naturally occurring sulphates in the earth's crust are calcium sulphate which occurs as gypsum (or selenite ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)) [Veith 20]. Sulphate may be present within the soil already or may be produced from the oxidation of sulphide minerals. Sometimes industrial activities are responsible for the presence of sulphates in soils. As the concentration of sulphate in soils increase, its detrimental effects also increase. Many researchers have reported examples of detrimental effects of sulphates, either naturally present in the ground or artificially added when soils are modified or stabilized with lime and/or cement [Mitchell 17 and Hunter 11] in USA. The expansion in lime-stabilized clay in the presence of sulfates is believed to be partly caused by the growth of ettringite crystals formed on the clay particle surfaces [Mitchell 17]. There is a deliberate bias and focus towards the more 'troublesome' sulfate-bearing soils, Lower Oxford Clay (LOC). In addition, there is an interest in the utilization of wastepaper sludge ash (WSA) as a soil stabilizer. WSA is an industrial by-product of wastepaper recycling and re-processing, that is increasingly becoming abundant in UK as paper recycling rates increase [Kinuthia et al. 14]. So far, the progress in this regard has been minimal. But now with the implementation of government schemes like —Pradhan Mantri Gram Sadak Yojana (PMGSY)‖, NHDP Project, Golden Quadrilateral Project, North South East Corridor Project, the road constructions scenario has taken a big leap forward. However, fund constraint, lacks of good quality construction materials in the vicinity of the project considerably hamper the progress. One of the major costs involved in road construction is the transportation of materials. To minimize this cost, the locally available materials should be used, particularly the soil. But if the soil available locally is not of good quality, it causes a major problems for this soil has to be stabilized suitably.

2. Literature Review

During the last few decades, many researchers have studied the behaviour of sulphate infected black cotton soil. Stabilization of soils with hydraulic binders is essential to improve their engineering properties. Therefore, they can be used, in situ, in geotechnical applications such as sub-base layer with the required performances. Sulphates and sulfides are naturally present in the soils, mainly as gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ or pyrite FeS_2 . Sulphates are widely recognised in altering soil stabilization, inducing considerable swellings. Le Borgne [10] describes the effects of 0.62 and 6.20 g of $\text{SO}_4^{2-} \cdot \text{kg}^{-1}$ (as gypsum) in silt treated with 1.5% of quicklime and 6% of cement CEMII. The effects are evaluated with various physical and mechanical tests. Xing et al. (2009) study the UCS of NaCl-rich soils (chloride concentrations from 1.54 to 16.00 $\text{g} \cdot \text{kg}^{-1}$), treated with 21% of cement CEMI 32.5: 8.00 g of chloride $\cdot \text{kg}^{-1}$ decrease the UCS values about 20% compared with a soil with 1.54 of chloride $\cdot \text{kg}^{-1}$. Parker [15] reported that sulfate attack of the lime stabilized capping layer of the new carriageways on the 7.5 km A10 Wadesmill bypass U.K. resulted in heave that left up to 25% of the carriageways buckled, cracked and ridged. Similarly, Wild et al. [21], researching on industrial kaolinite clay stabilized with various lime and gypsum contents, agreed with Mehta [16] that osmotic swelling would take place within the colloidal layer in regions of high sulfate concentration in close proximity to the developing ettringite rods at the clay particle surfaces. Research work by Kinuthia et al. [13] and Bai et al. [6] has established the principal crystalline components in WSA as typically calcium oxide (about 5 wt.% of which is free quicklime with traces of calcium hydroxide). The ash is highly alkaline (pH 11–12) probably as a result of the residual free CaO. Basu et al. [3] studied about the usage of jute synthetic

blended woven geotextile in construction of unpaved rural roads. Laboratory test results shows that, this woven geotextile can be suitable for use as a separation layer as well as a reinforcing material for construction of medium traffic-volume unpaved roads. The use of jute (z85%) in cross direction resulted in notable increase in modulus, breaking strength, CBR puncture resistance of the geotextiles as compared to 100% HDPEF geotextile. Bent and Broms [4] studied about the usage of geofabric in stabilizing very soft clay. The method has been used in Malaysia and Singapore to stabilize very soft clay in setting ponds with a shear strength of approximately 3kPa so that the area can be used for construction. They have observed that, Geo-fabric can be used to increase the bearing capacity of very soft clay so that the fill required for the preloading of the clay can be placed. Wild et al. [22] studied the lime stabilized sulphate bearing clay soils stabilized with ground granulated blast furnace slag (GGBFS) and have concluded that, partial substitution of lime with GGBFS gives improved 7 days and 28 days strengths for both kaolinite and Kimmeridge Clay, the maximum level of lime substitution is different for the two clay types. Bidula Bose [5] studied the geo-engineering properties of the virgin soil and fly ash treated soil and it was found that there was 55% increment in the CBR value when compared with the virgin soil. Anil and Sivapullaiah (2011) studied the effectiveness of fly ash with ground granulated blast furnace slag in the soil and it was found that the UCS of flyash-GGBFS mixture increases with the increase in the GGBFS content. And also it was observed that the strength increases with the curing period. Sahu [19] observed that, stabilized fly ash with optimum lime content shows maximum economy. Three combinations were tried, stabilized fly ash with 50% sand, optimum lime content and activators (optimum lime content+20% sand). The saving was 6.0, 25.3 and 20.3% respectively. It was seen that the rate of increase of CBR value of fly ash stabilized with lime is more than with sand.

From the above literature review, it appears that chlorides and sulphates have an influence on the properties of treated soils. However, no specific threshold concentrations could be defined to predict the stabilization disturbances in treated soils containing anions such as chlorides and/or sulfates. Hence, it is clear that only a few limited research works have been carried out on ground granulated blast furnace slag and waste paper ash (WSA) behaviour study on sulphate infected black cotton soil with fibers.

3. Experimental Investigation

Main objective of this experimental programme is to study the behavior of sulfate infected black cotton soil which is stabilized using silica fume and different fibers.

3.1 Preparation of Potassium Sulphate Solution and Soil Sample

Potassium sulphate (K_2SO_4) powder was used to raise the sulphate level in the soil. Potassium sulphate powder was mixed with the calculated amount of water and the solutions were prepared. In the study, potassium sulphate concentration 20000 ppm was used. A series of tests were first performed on compacted soil specimens without any admixture followed by additional tests.



Figure 1 Blending of artificial laboratory soil samples prior to compaction.

3.2 Maximum dry density and optimum moisture content test

This test was conducted to know the MDD and OMC of the freshly prepared soil sample for soil mix and for different combinations as per IS: 2720-1974, Part-6. Each soil sample was prepared by initial dry mixing of raw soil about 3kg. Then water was added about 3% of weight of soil sample and mixed again until the water spreads all over the soil. The dry and wet mixing of soil-water was carried out in a non-porous metal tray in order to avoid water loss. The soil samples were subjected to this test and respective optimum moisture content and maximum dry densities of all combinations were determined. Determination of water content was carried out by the oven drying method.

3.3 California bearing ratio test

This test was conducted to know the CBR of the freshly prepared soil sample for soil mix and for different combinations as per IS : 2720-1987, Part-XVI.

The test is performed by measuring the pressure required to penetrate a soil sample with a plunger of standard area. The measured pressure is then divided by the pressure required to achieve an equal penetration on a standard material. It is the ratio of force per unit area required to penetrate a soil mass with standard circular piston at the rate of 1.25mm/min. to that required for the corresponding penetration of a standard material. During immersion, water will flow into the sample due to capillary action. If after the first 3 days in the tank there is still little or no water at the top of the specimen, then water is added to the top of the specimen for the remainder of the soaking period prior to testing for strength.

3.4 Direct shear test

This test was conducted to know the shear strength parameter of the soil for the soil mix and for different combinations as per IS : 2720-1986, Part-13. For each test three specimen samples were extracted after compacting the soil specimen in the standard proctor mould. The specimen samples were tested with different normal stresses i.e., 100 kpa, 200 kpa and 300 kpa in undrained conditions. The proving ring readings were noted at fixed interval of horizontal dial gauge readings to study the stress-displacement behavior of soil specimen. The stress-horizontal displacement curves were plotted to study the stress displacement behavior of soil specimen. The shear strength parameters were also studied.

3.5 Unconfined compression shear test

This test was conducted to know the shear strength parameter of the soil for the soil mix and for different combinations as per IS : 2720-1973, Part-10. The shearing strength is commonly investigated by means of compression tests in which an axial load is applied to the specimen and increased until failure occurs. The unconfined compressive strength is the load per unit area at which unconfined cylindrical specimen of soil will fail in a simple compression test. If the unit axial compression force per unit area has not reached a maximum value up to 2 percent axial strain, unconfined compressive strength shall be considered the value obtained at 2 percent axial strength.

4. Experimental results of sulphate infected black cotton soil using silica fume as stabilization material.

4.1 Index properties of sulphate infected black cotton soil using silica fume as stabilization material.

Table 1 gives the index properties of black cotton soil using silica fume as stabilization material in it. The variation of specific gravity, liquid limit, plastic limit, plasticity index, shrinkage limit and pH value of silica fume based stabilization material are shown in figure 2 to figure 7.

Table 1- Index properties of sulphate infected B C soil using silica fume as stabilization material

Percentage replacement of B C soil by silicafume	Specific gravity	Average specific gravity	Liquid limit (%)	Average liquid limit (%)	Plastic limit (%)	Average plastic limit (%)	Plasticity index	Average plasticity index	Shrinkage limit (%)	Average shrinkage limit (%)
0	2.42	2.45	59.04	59.00	26.81	26.40	32.23	32.60	20.6	20.91
	2.46		59.12		26.45		32.67		21.28	
	2.48		58.85		25.94		32.91		20.84	
5	2.5	2.49	53.04	53.18	27.89	28.07	25.15	25.11	18.24	17.98
	2.48		53.35		28.29		25.06		17.86	
	2.49		53.15		28.04		25.11		17.84	
10	2.56	2.54	48.55	48.82	29.37	29.23	19.18	19.58	16.51	16.59
	2.54		49.69		28.85		20.84		16.42	
	2.53		48.21		29.48		18.73		16.85	
15	2.54	2.56	44.75	44.85	30.95	30.75	13.8	14.10	13.94	14.05
	2.58		44.68		30.59		14.09		14.21	
	2.55		45.13		30.71		14.42		14.01	
20	2.62	2.62	41.28	41.54	31.35	31.24	9.93	10.30	12.42	12.68
	2.64		42.15		31.61		10.54		13.04	
	2.61		41.18		30.75		10.43		12.58	
25	2.66	2.64	45.11	44.91	30.71	30.80	14.4	14.11	14.12	13.75
	2.64		44.85		31.07		13.78		13.89	
	2.63		44.76		30.62		14.14		13.24	
30	2.66	2.65	45.92	45.56	29.24	29.35	16.68	16.21	14.62	14.35
	2.63		45.85		29.75		16.1		14.46	
	2.65		44.91		29.07		15.84		13.98	
35	2.67	2.69	47.45	47.82	28.11	27.91	19.34	19.91	15.21	15.28
	2.71		47.92		27.85		20.07		15.47	
	2.68		48.08		27.77		20.31		15.16	
40	2.72	2.74	49.48	49.23	27.48	27.56	22	21.67	17.32	17.18
	2.74		49.02		27.68		21.34		17.15	
	2.75		49.18		27.52		21.66		17.06	

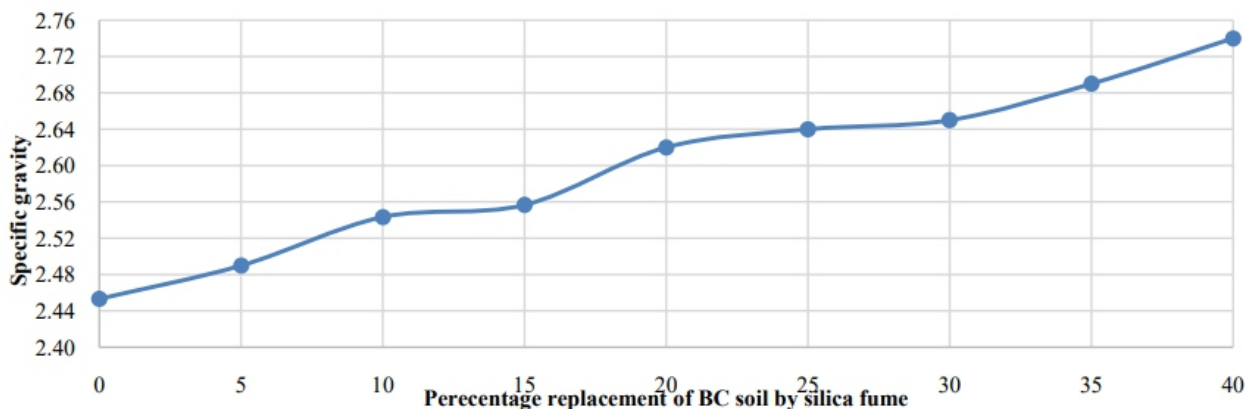


Figure 2 Variation of specific gravity for different percentage replacement of BC soil by silica fume.

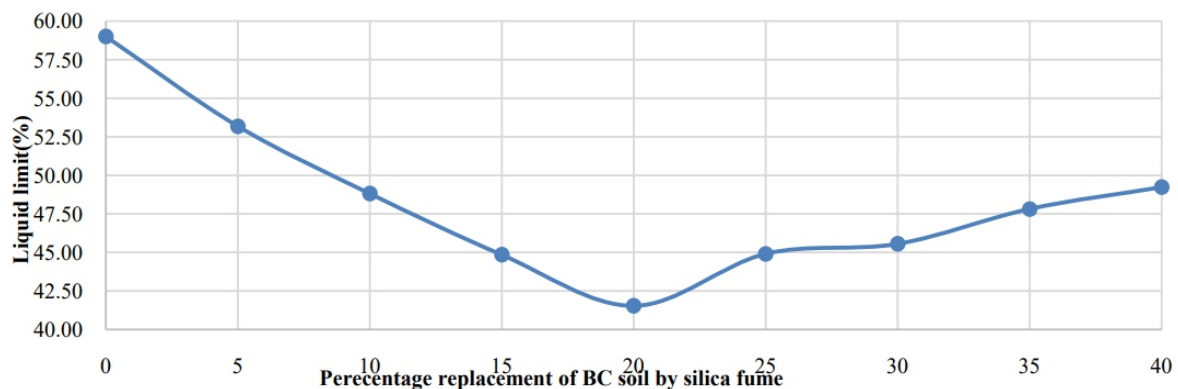


Figure 3 Variation of liquid limit for different percentage replacement of BC soil by silica fume.

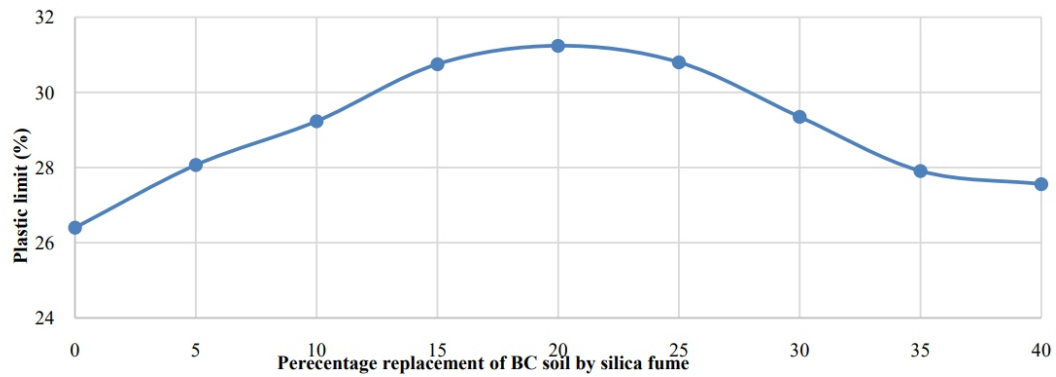


Figure 4 Variation of plastic limit for different percentage replacement of BC soil by silica fume.

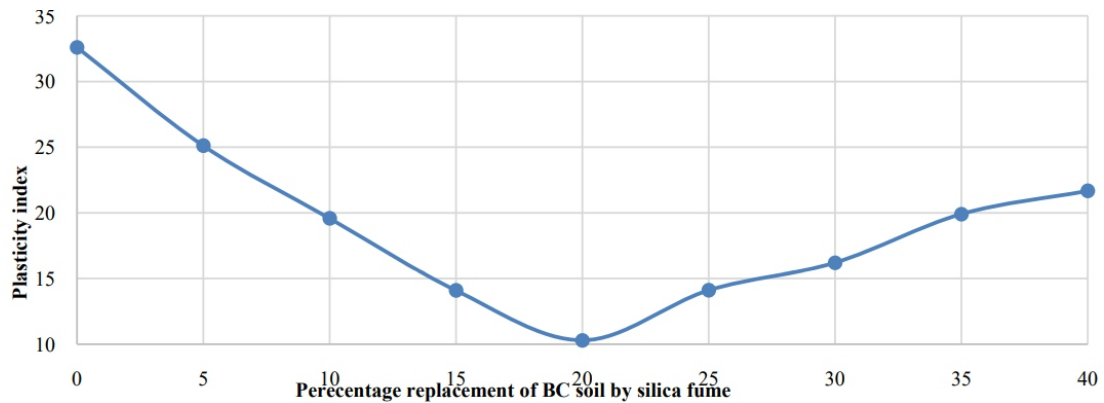


Figure 5 Variation of plasticity index for different percentage replacement of BC soil by silica fume.

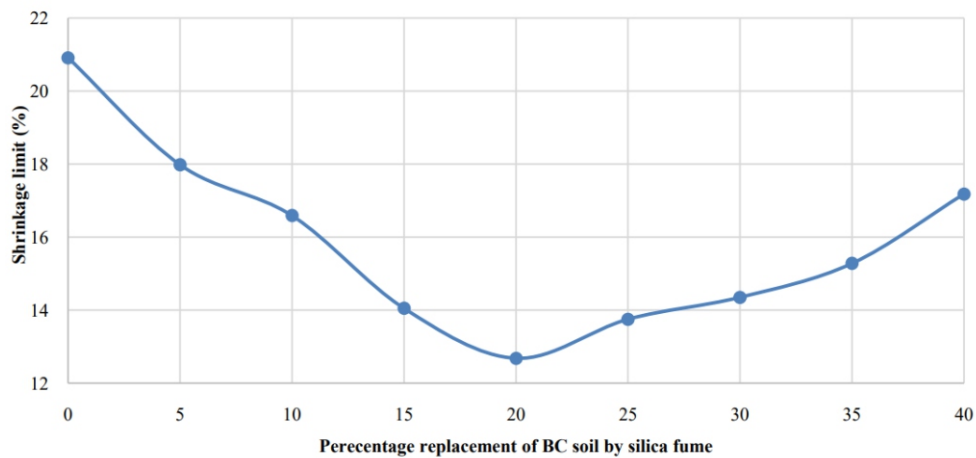


Figure 6 Variation of shrinkage limit for different percentage replacement of BC soil by silica fume.

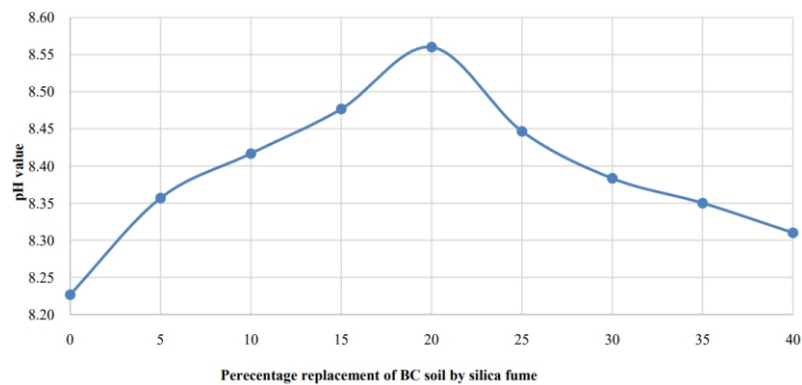


Figure 7 Variation of pH for different percentage replacement of BC soil by silica fume.

It is observed that the sulphate infected black cotton soil using silica fume as stabilization material has shown improved index properties at 20% replacement level. Table 1 and related graphs show the improvement in index properties for sulphate infected black cotton soil when treated with silica fume as stabilization material with 20% replacement level.

Liquid limit and shrinkage limit values show a decreasing trend upto 20% replacement of black cotton soil by silica fume. After 20% replacement level, liquid limit and shrinkage limit values go on increasing. The percentage decrease in liquid limit and shrinkage limit at 20% replacement level are found to be 29.59% and 39.37% respectively with respect to reference mix. Plastic limit shows an increasing trend upto 20% replacement of black cotton soil by silica fume. After 20% replacement level, plastic limit goes on decreasing. The percentage increase in plastic limit at 20% replacement level is found to be 15.49% with respect to reference mix. Plasticity index which is an effective parameter for controlling the swell potential of soil, is also less at 20% replacement level. The percentage decrease in plasticity index at 20% replacement level is found to be 68.40% with respect to reference mix. Higher the plasticity index, higher is the swell.

This may be attributed to the fact that at 20% replacement of black cotton soil by silica fume, an appropriate development of a cementitious matrix, resulting from the pozzolonic reactions forming calcium silicate hydrates (CSH), calcium aluminosilicate hydrates (CASH) and calcium aluminate hydrates (CAH) under the localized alkaline conditions within the soil matrix.

Thus, it may be concluded that the sulphate infected black cotton soil using silica fume as stabilizing material shows improved index properties at 20% replacement level.

4.2 Stress resistance properties of sulphate infected B C soil using silica fume as stabilization material.

Table 2 to table 3 gives the stress resistance properties of sulphate infected B C soil using silica fume as stabilization material. The variation in MDD, OMC, unsoaked CBR, soaked CBR, cohesion, angle of shearing resistance (ϕ), UCC cohesion and UCC (α) are shown in figure 8 to figure 15.

Table 2 Stress resistance properties of sulphate infected B C soil using silica fume as stabilization material.

Percentage replacement of B C soil by silica fume	MDD (gm/cc)	Average MDD (gm/cc)	OMC (%)	Average OMC (%)	CBR (Unsoaked) (%)	Average CBR (Unsoaked) (%)	CBR (Soaked) (%)	Average CBR (Soaked) (%)
0	1.64	1.62	22.86	22.92	3.22	3.29	2.54	2.57
	1.61		22.98		3.34		2.56	
	1.6		22.93		3.32		2.61	
5	1.74	1.72	23.49	23.20	4.92	4.85	3.88	3.85
	1.69		23.21		4.88		3.95	
	1.73		22.89		4.76		3.71	
10	1.81	1.82	23.75	23.60	5.68	5.75	4.26	4.38
	1.82		23.54		5.72		4.22	
	1.83		23.51		5.84		4.65	
15	1.87	1.89	24.81	24.91	6.58	6.38	4.96	4.87
	1.91		25.38		6.51		4.76	
	1.88		24.54		6.06		4.88	
20	1.93	1.92	25.37	25.67	6.84	6.95	5.33	5.21
	1.94		25.89		6.89		5.12	
	1.89		25.74		7.11		5.18	
25	1.89	1.88	26.37	26.15	6.25	6.34	4.82	4.75
	1.88		25.96		6.61		4.95	
	1.86		26.12		6.16		4.48	
30	1.81	1.82	27.51	27.34	5.89	5.97	4.57	4.37
	1.79		27.36		5.85		4.49	
	1.85		27.14		6.18		4.05	
35	1.79	1.78	27.98	27.86	5.18	5.24	3.89	4.02
	1.77		27.68		5.23		4.12	
	1.78		27.92		5.31		4.04	
40	1.74	1.75	28.55	28.35	4.83	4.91	3.95	3.86
	1.73		27.85		4.91		3.89	
	1.78		28.65		4.98		3.74	

Table 3 Some more stress resistance properties of sulphate infected B C soil using silica fume as stabilization material.

Percentage replacement of B C soil by silica fume	Cohesion from direct shear test (kg/cm ²)	Average cohesion (kg/cm ²)	Angle of shearing resistance from direct shear test (φ)(degree)	Average angle of shearing resistance (φ) (degree)	UCC cohesion (kg/cm ²)	Average UCC cohesion (kg/cm ²)	UCC (α)	Average UCC (α)
0	8.92	9.10	18.12	18.36	8.86	8.90	16.74	16.75
	9.28		18.65		9.08		16.58	
	9.11		18.31		8.76		16.92	
5	11.05	11.28	16.88	16.84	11.73	11.54	15.86	16.00
	11.46		16.98		11.62		16.15	
	11.33		16.65		11.28		15.98	
10	12.71	12.81	15.81	15.96	12.66	12.53	15.46	15.50
	12.64		16.12		12.58		15.75	
	13.08		15.94		12.35		15.28	
15	14.07	13.98	14.25	14.20	13.86	13.67	15.24	15.25
	13.95		14.22		13.71		15.31	
	13.92		14.12		13.45		15.19	
20	14.72	14.62	13.72	13.68	14.31	14.16	14.47	14.48
	14.68		13.55		14.21		14.56	
	14.46		13.78		13.97		14.42	
25	13.57	13.68	13.87	13.95	12.84	13.14	14.75	14.87
	13.65		14.12		13.26		14.92	
	13.82		13.86		13.31		14.95	
30	12.86	12.92	14.26	14.15	12.14	12.02	15.19	15.10
	12.75		14.14		11.89		15.07	
	13.14		14.05		12.04		15.03	
35	12.84	12.54	14.96	14.86	11.82	11.76	15.84	15.67
	12.45		14.88		11.67		15.57	
	12.34		14.75		11.79		15.61	
40	11.89	11.92	15.71	15.93	11.51	11.44	16.28	16.35
	12.02		15.86		11.32		16.31	
	11.86		16.23		11.48		16.45	

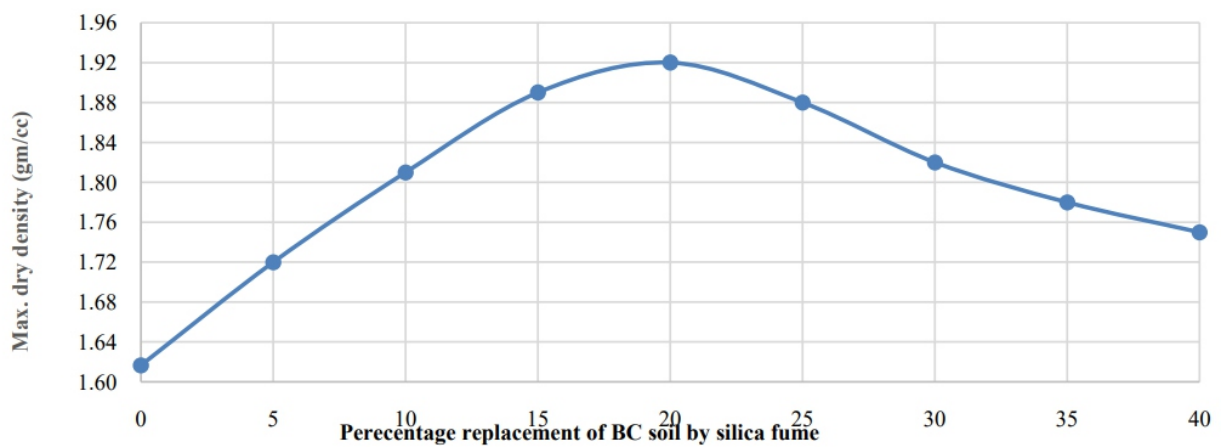


Figure 8 Variation of max. dry density for different percentage replacement of BC soil by silica fume.

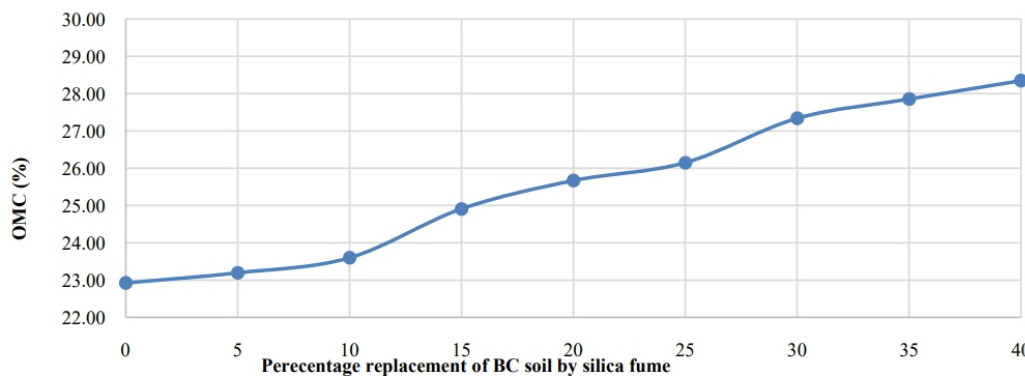


Figure 9 Variation of optimum moisture content for different percentage replacement of BC soil by silica

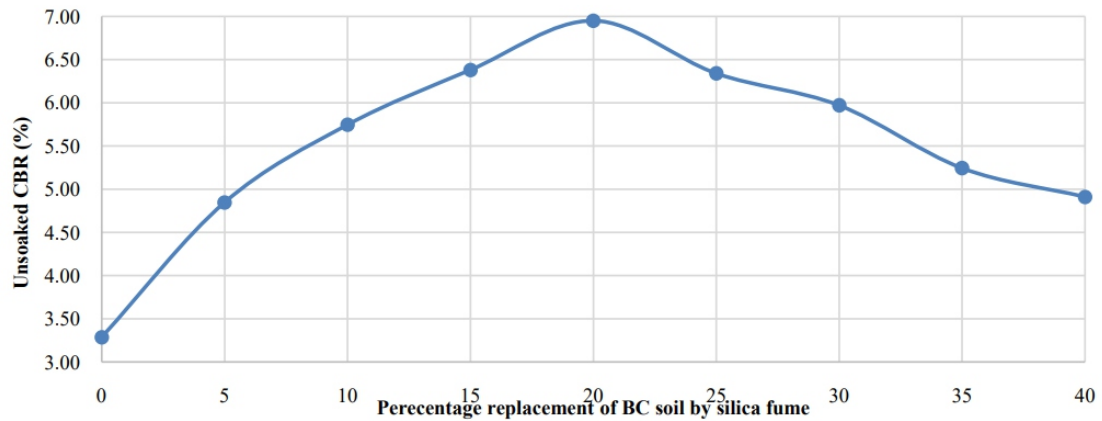


Figure 10 Variation of unsoaked CBR for different percentage replacement of BC soil by silica fume.

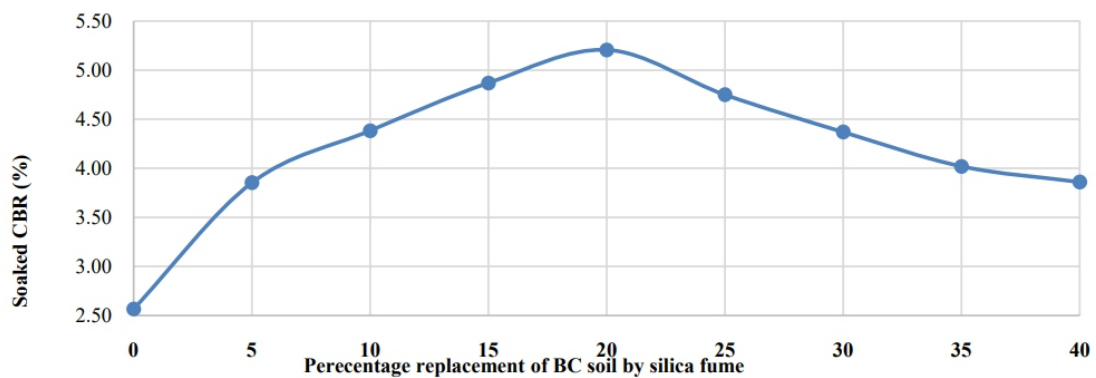


Figure 11 Variation of soaked CBR for different percentage replacement of BC soil by silica fume.

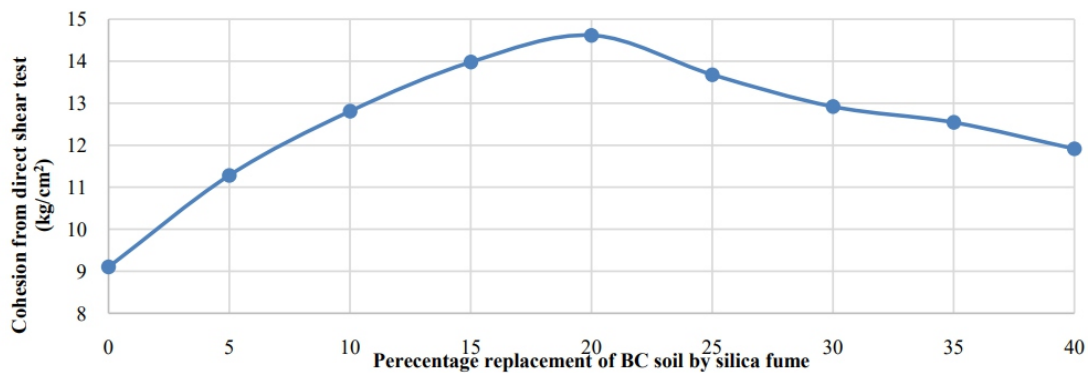


Figure 12 Variation of cohesion of direct shear test for different percentage replacement of BC soil by silica fume.

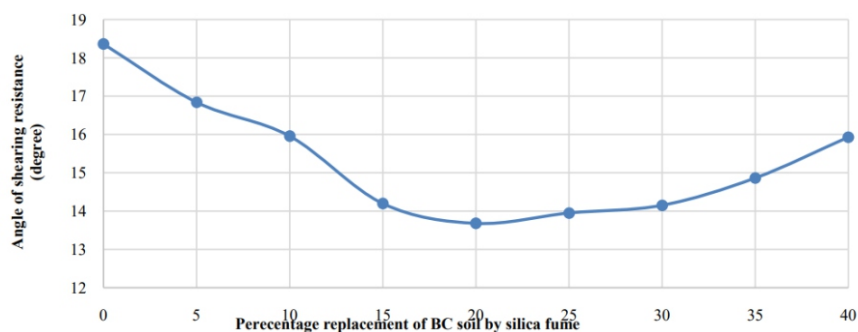


Figure 13 Variation of angle of shearing resistance of direct shear test for different percentage replacement of BC soil by silica fume

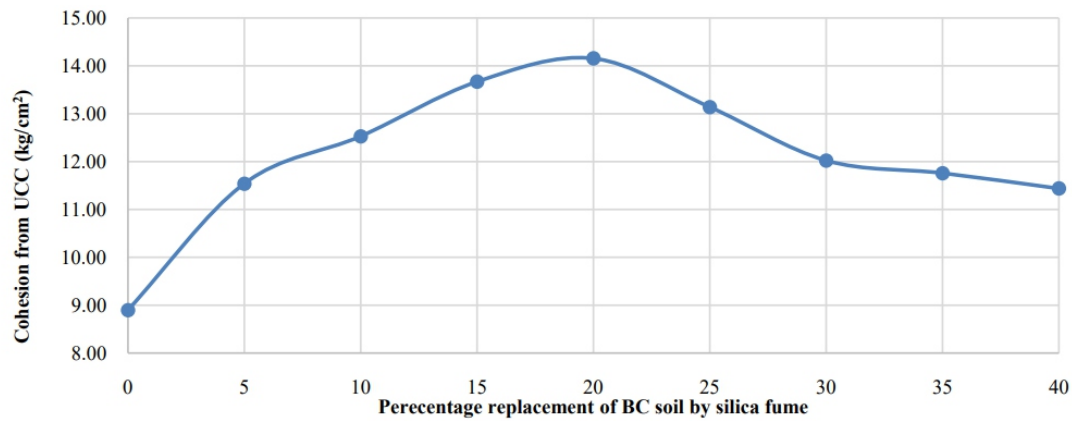


Figure 14 Variation of Cohesion of UCC test for different percentage replacement of BC soil by silica fume.

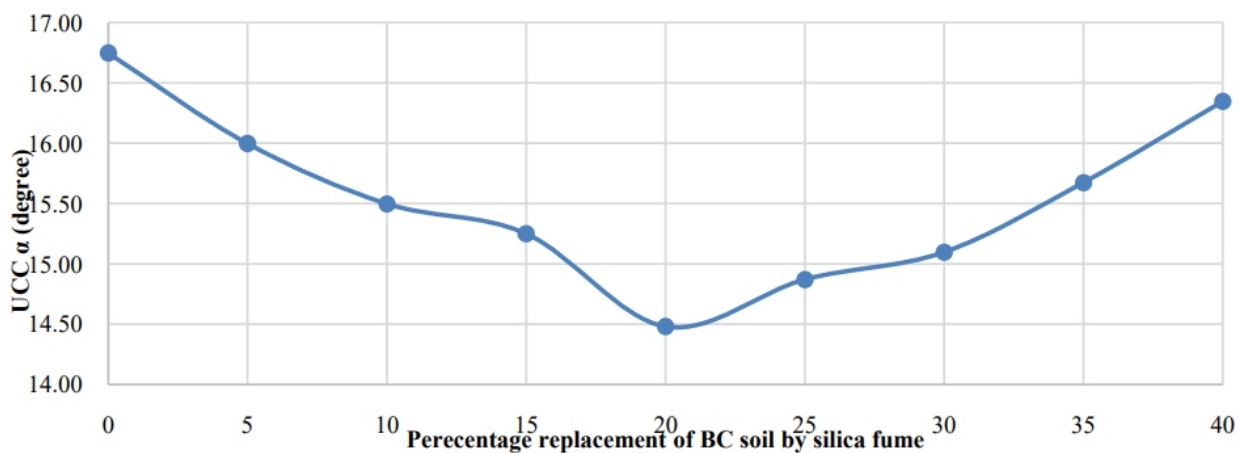


Figure 15 Variation of α of UCC test for different percentage replacement of BC soil by silica fume.

It is observed that the sulphate infected black cotton soil using silica fume as stabilization material has shown improved stress resistance properties at 20% replacement level. Table 2 and table 3 and related graphs show the improvement in stress resistance properties for sulphate infected black cotton soil when treated with silica fume as stabilization material with 20% replacement level.

Unsoaked CBR value, soaked CBR value, cohesion value from direct shear test and UCC test cohesion value, all show an increasing trend upto 20% replacement of black cotton soil by silica fume. After 20% replacement level, all the above values go on decreasing. The percentage increase in unsoaked CBR value, soaked CBR value, cohesion value from direct shear test and UCC test cohesion value at 20% replacement level are found to be 52.71%, 50.70%, 37.72% and 37.13% respectively with respect to reference mix. Angle of shearing resistance Φ obtained by direct shear test and α value obtained by UCC test shows a decreasing trend upto 20% replacement of black cotton soil by silica fume. The percentage decrease in angle of shearing resistance Φ obtained by direct shear test and α value obtained by UCC test at 20% replacement level are found to be 25.49% and 13.54% respectively with respect to reference mix.

This may be due to the fact that at 20% replacement of black cotton soil by silica fume, an appropriate colloidal product may be formed which consists of a complex calcium-sulpho-aluminate-silicate hydrate (CA-S-S-H) on the surface of the clay plates. From this colloidal surface product, a crystalline compound commonly known as ettringite (C3A-3C S-H32) nucleates. Ettringite is known to impart significant strength enhancement, due to its needle like crystal crystalline morphology.

This may be due to the fact that at 20% replacement of black cotton soil by silica fume, an appropriate colloidal product may be formed which consists of a complex calcium-sulpho-aluminate-silicate hydrate (CA-S- S-H) on the surface of the clay plates. From this colloidal surface product, a crystalline compound commonly known as ettringite (C3A-3C S-H32) nucleates. Ettringite is known to impart significant strength enhancement, due to its needle like crystal crystalline morphology.

Thus, it may be concluded that the sulphate infected black cotton soil using silica fume as stabilizing material show improved stress resistance properties at 20% replacement level.

4.3 Stress resistance properties of sulphate infected B C soil using silica fume as stabilization material along with monofibres.

Table 4 and table 5 gives the stress resistance properties of sulphate infected B C soil using silica fume as stabilization material at 20% replacement level along with monofibres like HDPE, Polypropylene, waste plastic and jute fibres. The variation in unsoaked CBR value and soaked CBR value for different monofibres are shown in figure 16 to figure 23

Table 4 Stress resistance properties of sulphate infected B C soil using silica fume as stabilization material along with monofibers like HDPE fibres and PPF fibres

Percentage of fibres added by volume fraction	HDPE fibres				Polypropylene fibres			
	CBR (Unsoaked) (%)	Average CBR (Unsoaked) (%)	CBR (Soaked) (%)	Average CBR (Soaked) (%)	CBR (Unsoaked) (%)	Average CBR (Unsoaked) (%)	CBR (Soaked) (%)	Average CBR (Soaked) (%)
0.0	6.84	6.95	5.33	5.21	6.84	6.95	5.33	5.21
	6.89		5.12		6.89		5.12	
	7.11		5.18		7.11		5.18	
0.5	10.45	10.24	9.26	9.34	9.92	9.84	7.82	7.92
	10.18		9.52		9.76		8.02	
	10.08		9.23		9.83		7.91	
1.0	12.27	12.38	10.65	10.52	10.92	11.08	9.89	9.86
	12.48		10.42		11.21		9.98	
	12.39		10.48		11.12		9.71	
1.5	14.34	14.15	11.34	11.16	12.56	12.68	10.23	10.16
	14.08		11.21		12.81		10.35	
	14.02		10.92		12.67		9.89	
2.0	12.89	12.95	10.75	10.89	11.55	11.37	9.31	9.24
	12.78		10.85		11.28		9.28	
	13.18		11.07		11.29		9.12	

Table 5 Stress resistance properties of sulphate infected B C soil using silica fume as stabilization material along with monofibers like WPF fibres and Jute fibres

Percentage of fibres added by volume fraction	Waste plastic fibres				Jute fibres			
	CBR (Unsoaked) (%)	Average CBR (Unsoaked) (%)	CBR (Soaked) (%)	Average CBR (Soaked) (%)	CBR (Unsoaked) (%)	Average CBR (Unsoaked) (%)	CBR (Soaked) (%)	Average CBR (Soaked) (%)
0.0	6.84	6.95	5.33	5.21	6.84	6.95	5.33	5.21
	6.89		5.12		6.89		5.12	
	7.11		5.18		7.11		5.18	
0.5	9.87	9.75	6.96	7.16	7.87	7.84	6.24	6.18
	9.72		7.28		7.75		6.08	
	9.65		7.23		7.89		6.21	
1.0	10.34	10.23	8.24	8.34	8.35	8.18	6.27	6.31
	10.21		8.36		8.14		6.24	
	10.13		8.41		8.06		6.41	
1.5	11.28	11.31	9.68	9.62	9.04	8.96	7.39	7.52
	11.41		9.59		8.92		7.55	
	11.24		9.58		8.91		7.61	
2.0	9.81	9.84	8.21	8.28	8.18	8.27	6.74	6.85
	9.78		8.38		8.23		6.98	
	9.92		8.25		8.39		6.82	

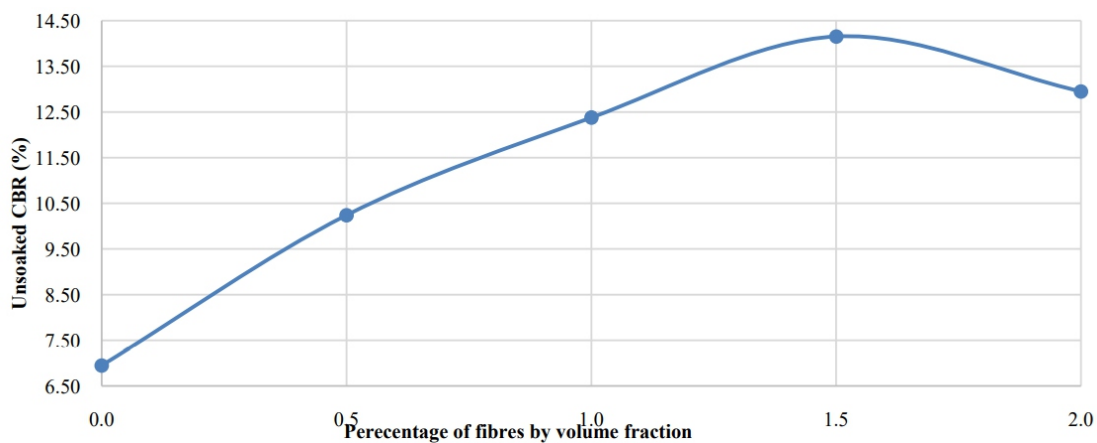


Figure 16 Variation of unsoaked CBR for different percentage of HDPE fibres when BC soil is replaced by silica fume.

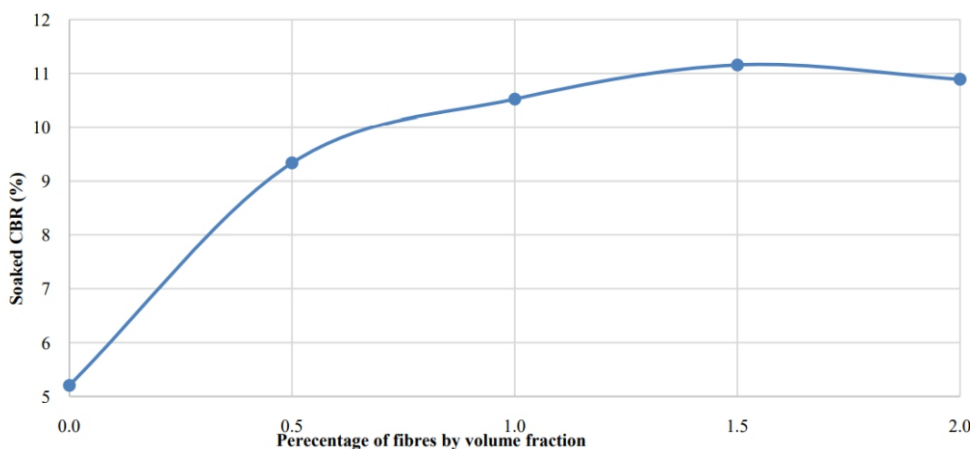


Figure 17 Variation of soaked CBR for different percentage of HDPE fibres when BC soil is replaced by silica fume.

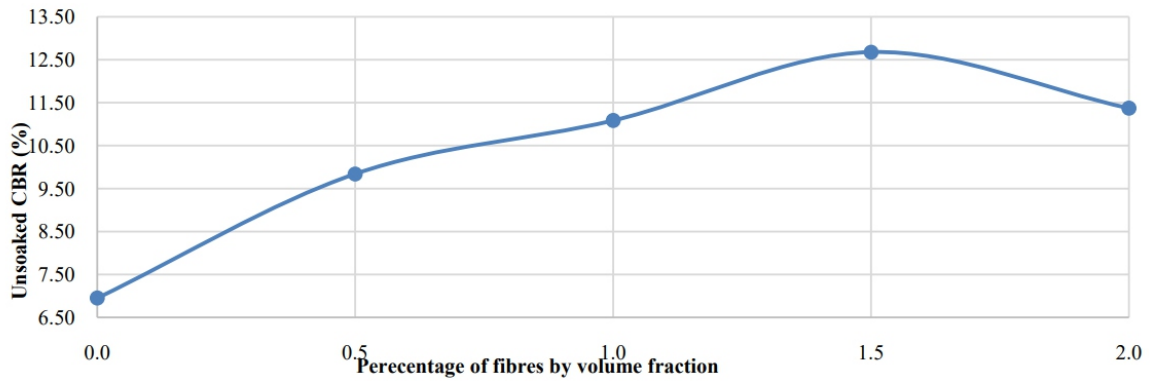


Figure 18 Variation of unsoaked CBR for different percentage of polypropylene fibres when BC soil is replaced by silica fume.

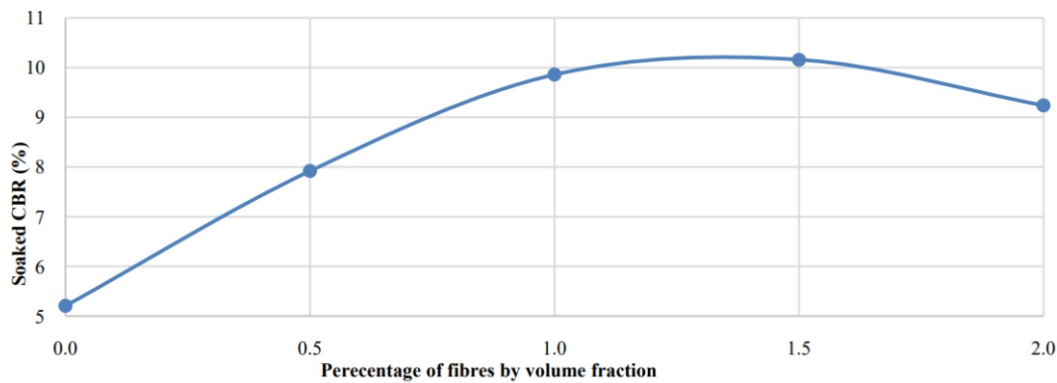


Figure 19 Variation of soaked CBR for different percentage of polypropylene fibres when BC soil is replaced by silica fume.

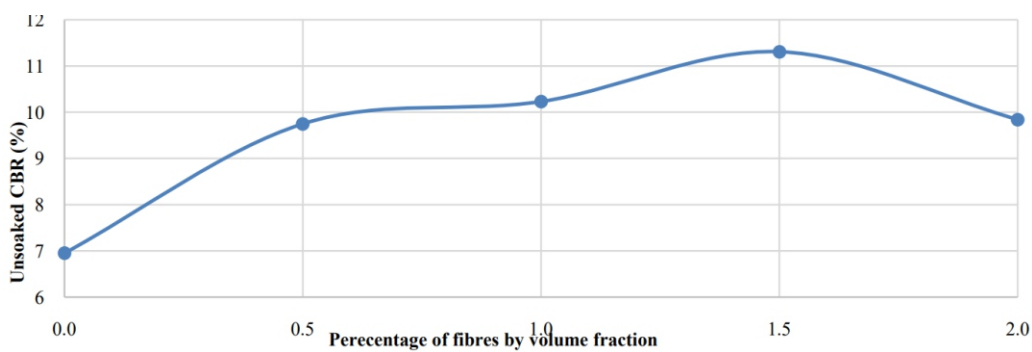


Figure 20 Variation of unsoaked CBR for different percentage of waste plastic fibres when BC soil is replaced by silica fume.

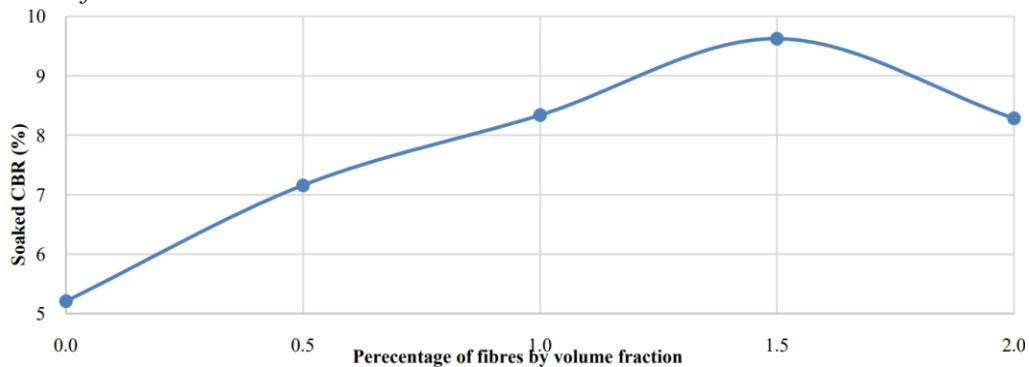


Figure 21 Variation of soaked CBR for different percentage of waste plastic fibres when BC soil is replaced

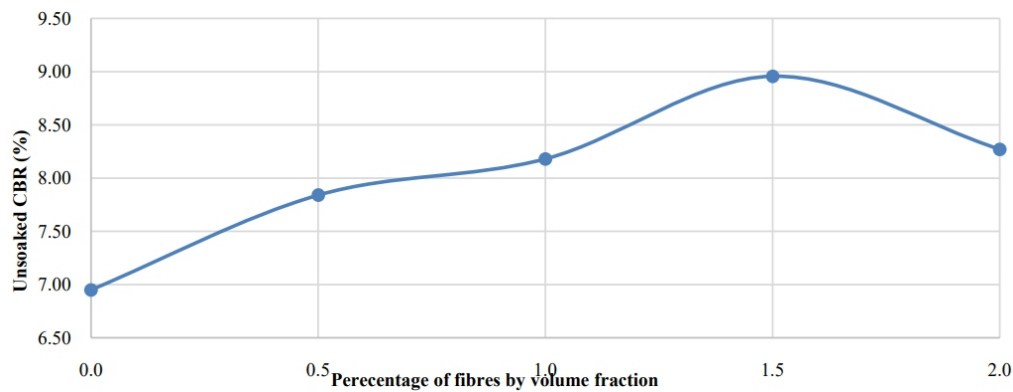


Figure 22 Variation of unsoaked CBR for different percentage of jute fibres when BC soil is replaced by silica fume.

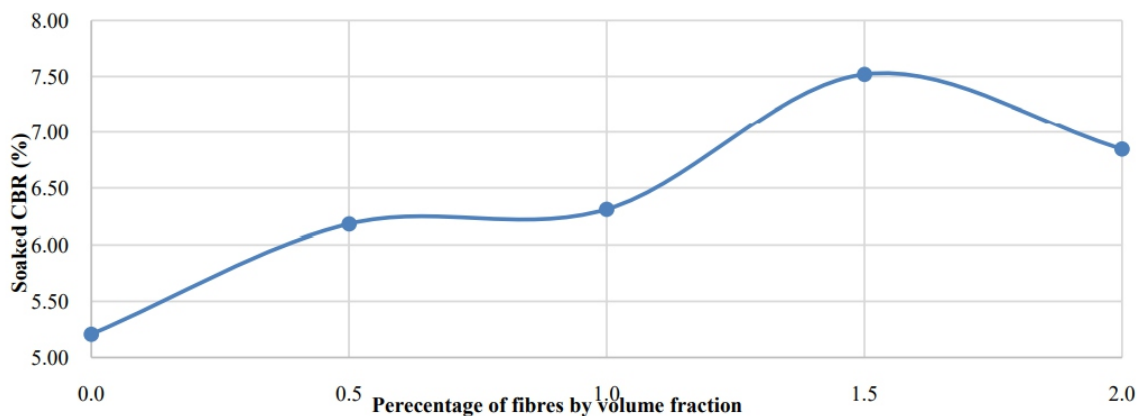


Figure 23 Variation of soaked CBR for different percentage of jute fibres when BC soil is replaced by silica fume.

It is observed that the sulphate infected black cotton soil using silica fume as stabilization material along with monofibres has shown improved stress resistance properties when monofibres are added at 1.5% by volume fraction. Table 5.21 and related graphs show the improvement in stress resistance properties for sulphate infected black cotton soil when 20% black cotton soil is replaced by silica fume and different monofibres are used. Various monofibres such as HDPE fibres, Polypropylene fibres, waste plastic fibres and jute fibres all have shown good results at 1.5% dosage level. Unsoaked CBR value and soaked CBR value have shown an increasing trend upto 1.5% addition of fibres. The percentage increase in unsoaked CBR value for various monofibres such as HDPE fibres, polypropylene fibres, waste plastic fibres and jute fibres, at 1.5% dosage are found to be 50.89%, 45.17%, 38.53% and 22.40% respectively with respect to reference mix. The percentage increase in soaked CBR value for various monofibres such as HDPE fibres, polypropylene fibres, waste plastic fibres and jute fibres, at 1.5% dosage are found to be 53.33%, 48.75%, 45.90% and 30.76% respectively with respect to reference mix.

Thus, it is clearly seen that addition of monofibres have dramatically increased the stress resistance properties of sulphate infected black cotton soil treated with silica fume.

This may be attributed to the fact that the addition of fibres to the soil increase the interfacial bond, thereby increasing the friction between soil and fibres. This renders it difficult for soil particles that surround fibres to change in position from one point to another and thereby improving the bond force between soil particles. When local cracks appears in the soil, fibres across the crack will take on the tension in the soil, which effectively impedes further development of cracks and improves the resistance of the soil to the force applied. Thus, the crack can be prevented by bridging effect of fibres. Further, the cementitious matrix produced from the pozzolonic reaction by the stabilizing material, may cover around the fibre surface may improve the interfacial bond and may increase

the friction co-efficient between soil and fibres.

Thus, it may be concluded that the addition of monofibres such as HDPE fibres, polypropylene fibres, waste plastic fibres and jute fibres to sulphate infected black cotton soil using silica fume as stabilizing material significantly enhance the stress resistance properties.

From the results obtained, it may also be concluded that, the performance of HDPE fibres is better than polypropylene fibres, waste plastic fibres and jute fibres in enhancing the stress resistance properties of sulphate infected black cotton soil using silica fume as stabilization material.

4.4 Stress resistance properties of sulphate infected B C soil using silica fume as stabilization material along with hybrid fibres.

Table 6 and table 7 gives the stress resistance properties of sulphate infected B C soil using silica fume as stabilization material at 20% replacement level along with hybrid fibres like (PPF+HDPEF), (PPF+WPF) and (JF+WPF). The variation in unsoaked CBR value and soaked CBR value for different hybrid fibre combinations are shown in figure 24 to figure 29.

Table 6. Stress resistance properties of sulphate infected B C soil using silica fume as stabilization material along with hybrid fibers like (PPF+HDPEF) & (PPF+WPF)

Percentage of hybrid fibres added by volume fraction	(PPF + HDPEF)				(PPF + WPF)			
	CBR (Unsoaked) (%)	Average CBR (Unsoaked) (%)	CBR (Soaked) (%)	Average CBR (Soaked) (%)	CBR (Unsoaked) (%)	Average CBR (Unsoaked) (%)	CBR (Soaked) (%)	Average CBR (Soaked) (%)
(0%+0%)	6.84	6.95	5.33	5.21	6.84	6.95	5.33	5.21
	6.89		5.12		6.89		5.12	
	7.11		5.18		7.11		5.18	
(0.25%+0.25%)	12.12	11.84	9.31	9.27	10.18	10.04	7.71	7.64
	11.75		9.18		9.98		7.68	
	11.65		9.31		9.95		7.54	
(0.5%+0.5%)	13.24	13.28	10.45	10.65	10.72	10.58	8.75	8.82
	13.21		10.59		10.48		8.92	
	13.38		10.92		10.54		8.78	
(0.75%+0.75%)	14.24	14.14	10.89	11.04	11.98	12.10	9.72	9.63
	14.07		10.98		12.24		9.57	
	14.12		11.24		12.08		9.61	
(1%+1%)	13.58	13.65	10.35	10.29	11.48	11.27	9.22	9.25
	13.48		10.18		11.26		9.15	
	13.89		10.34		11.08		9.38	

Table 7. Stress resistance properties of sulphate infected B C soil using silica fume as stabilization material along with hybrid fibers like (JF+WPF)

Percentage of hybrid fibres added by volume fraction	(JF + WPF)			
	CBR (Unsoaked) (%)	Average CBR (Unsoaked) (%)	CBR (Soaked) (%)	Average CBR (Soaked) (%)
(0%+0%)	6.84	6.95	5.33	5.21
	6.89		5.12	
	7.11		5.18	
(0.25%+0.25%)	9.68	9.56	7.22	7.36
	9.45		7.63	
	9.56		7.24	
(0.5%+0.5%)	10.52	10.48	8.55	8.42
	10.68		8.45	
	10.25		8.26	
(0.75%+0.75%)	11.14	11.12	9.15	9.18
	11.21		9.24	
	11.01		9.15	
(1%+1%)	10.62	10.52	8.62	8.45
	10.48		8.28	
	10.45		8.46	

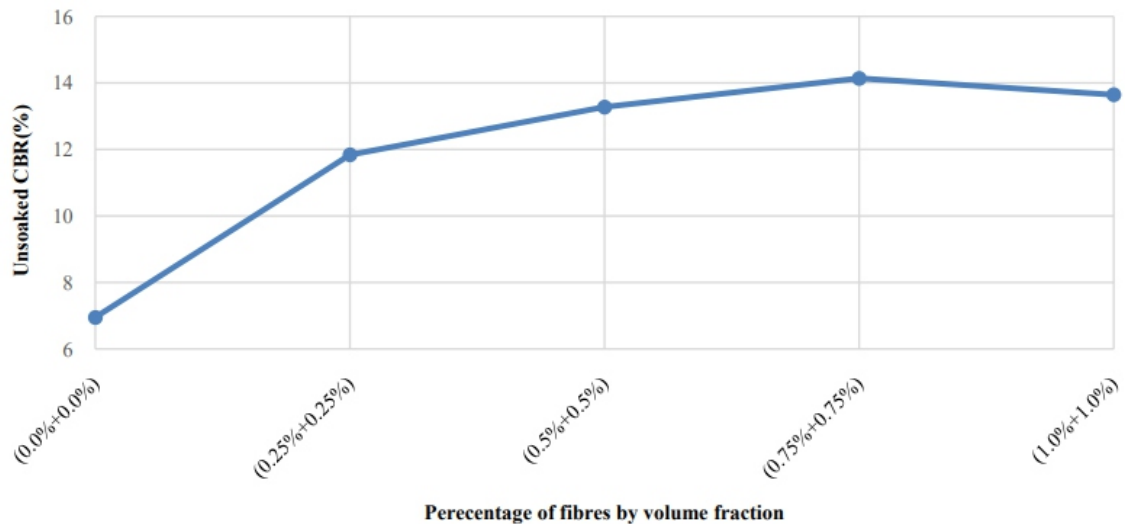


Figure 24 Variation of unsoaked CBR for different percentage of (PPF + HDPEF) when BC soil is replaced by silica fume.

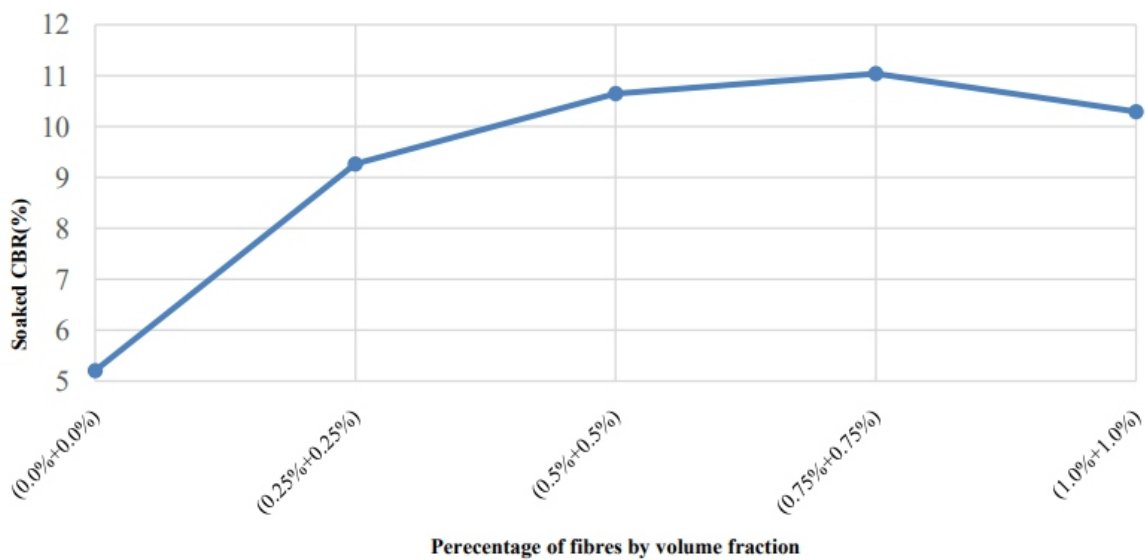


Figure 25 Variation of soaked CBR for different percentage of (PPF + HDPEF) when BC soil is replaced by silica fume.

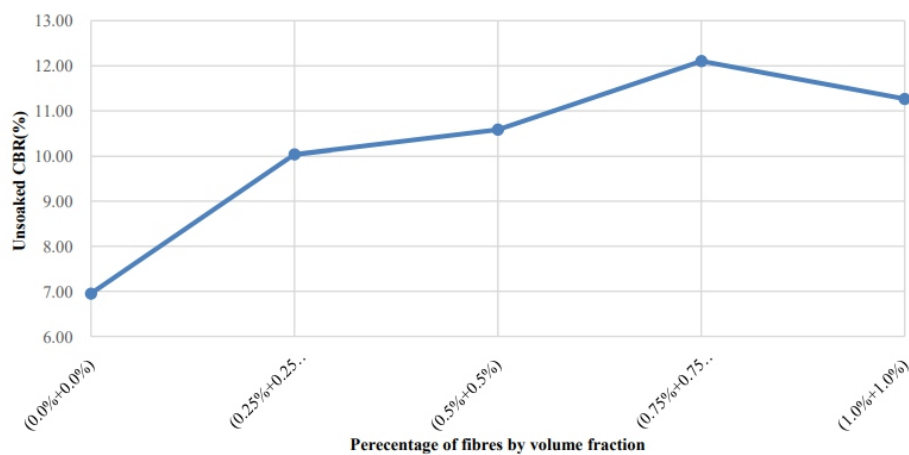


Figure 26 Variation of unsoaked CBR for different percentage of (PPF + WPF) when BC soil is replaced by silica fume.

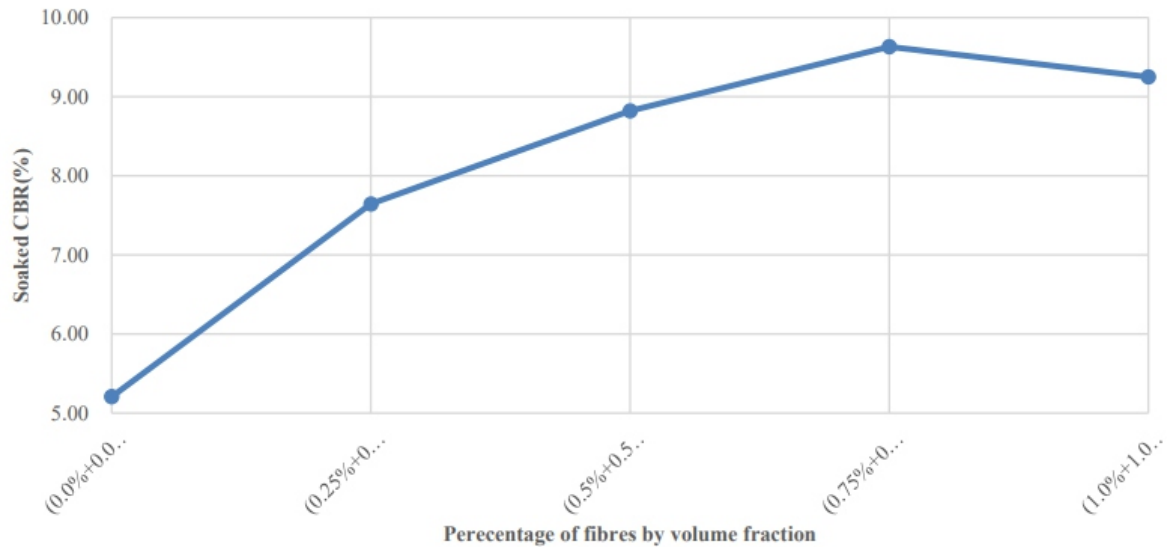


Figure 27 Variation of soaked CBR for different percentage of (PPF + WPF) when BC soil is replaced by silica fume.

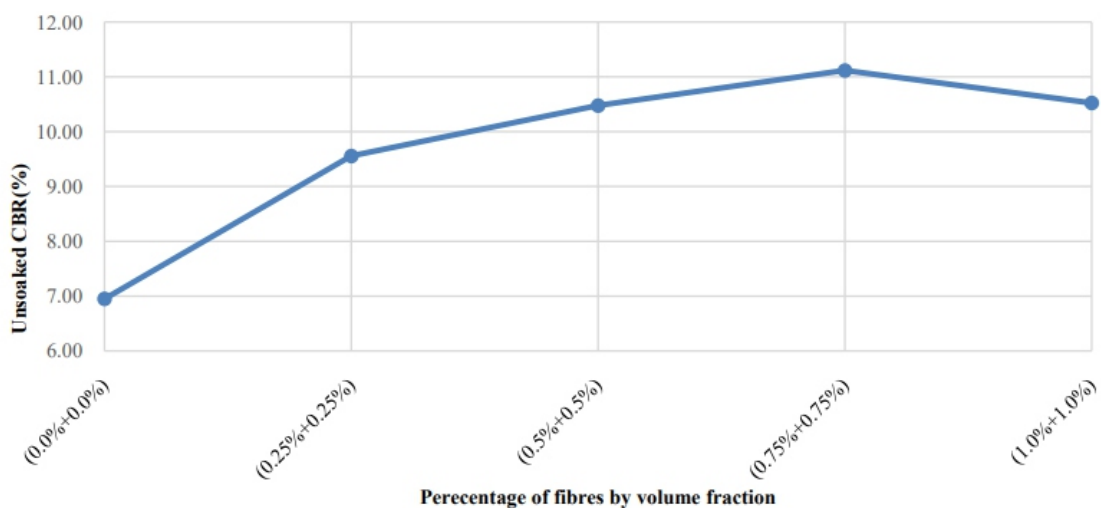


Figure 28 Variation of unsoaked CBR for different percentage of (JF + WPF) when BC soil is replaced by silica fume.

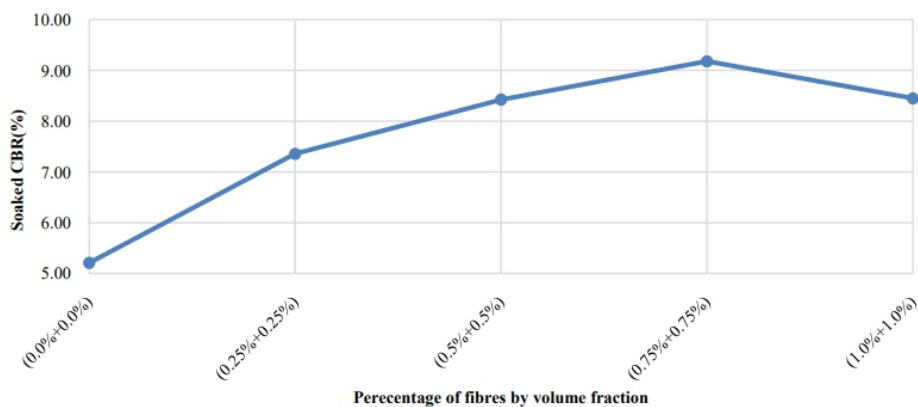


Figure 29 Variation of soaked CBR for different percentage of (JF + WPF) when BC soil is replaced by silica fume.

It is observed that the sulphate infected black cotton soil using silica fume as stabilization material along with hybrid fibres has shown improved stress resistance properties when hybrid fibres are added at (0.75%+0.75%) by volume fraction. Table 6 and table 7 and related graphs show the improvement in stress resistance properties for sulphate infected black cotton soil when 20% black cotton soil is replaced by silica fume and different combination of hybrid fibres are used. Various hybrid fibre combination such as (PPF+HDPEF), (PPF+WPF), and (JF+WPF) all have shown good results at (0.75%+0.75%) dosage level. Unsoaked CBR value and soaked CBR value have shown an increasing trend upto (0.75%+0.75%) addition of fibres. The percentage increase in unsoaked CBR value for various combination of hybrid fibres such as (PPF+HDPEF), (PPF+WPF), and (JF+WPF) at (0.75%+0.75%) dosage are found to be 50.85%, 42.58% and 37.48% respectively with respect to reference mix. The percentage increase in soaked CBR value for various combination of hybrid fibres such as (PPF+HDPEF), (PPF+WPF), and (JF+WPF) at (0.75%+0.75%) dosage are found to be 52.84%, 45.93% and 43.28% respectively with respect to reference mix.

Thus, it is clearly seen that addition of hybrid fibres have significantly increased the stress resistance properties of sulphate infected black cotton soil treated with silica fume.

This may be attributed to the fact that the addition of hybrid fibres to the soil increase the interfacial bond, thereby increasing the friction between soil and fibres. This renders it difficult for soil particles that surround fibres to change in position from one point to another and thereby improving the bond force between soil particles. When local cracks appears in the soil, fibres across the crack will take on the tension in the soil, which effectively impedes further development of cracks and improves the resistance of the soil to the force applied. Thus, the crack can be prevented by bridging effect of fibres. Further, the cementitious matrix produced from the pozzolonic reaction by the stabilizing material, may cover around the fibre surface may improve the interfacial bond and may increase the friction co-efficient between soil and fibres. Further more, the hybrid fibres will act synergistically and play their role in bridging the small cracks and large cracks.

Thus, it may be concluded that the addition of hybrid fibres such as (PPF+HDPEF), (PPF+WPF), and (JF+WPF) to sulphate infected black cotton soil using silica fume significantly enhance the stress resistance properties.

From the results obtained, it may also be concluded that, the performance hybrid fibre combination (PPF+HDPEF) is better than (PPF+WPF) and (JF+WPF) in enhancing the stress resistance properties of sulphate infected black cotton soil using silica fume as stabilization material

5. Conclusions

Following conclusions may be drawn from the study.

1. The sulphate infected black cotton soil using silica fume as stabilizing material shows improved index properties at 20% replacement level.
2. The sulphate infected black cotton soil using silica fume as stabilizing material show improved stress resistance properties at 20% replacement level.
3. The addition of monofibres such as HDPE fibres, polypropylene fibres, waste plastic fibres and jute fibres to sulphate infected black cotton soil using silica fume as stabilizing material significantly enhance the stress resistance properties.
4. The performance of HDPE fibres is better than polypropylene fibres, waste plastic fibres and jute fibres in enhancing the stress resistance properties of sulphate infected black cotton soil using silica fume as stabilization material.
5. The addition of hybrid fibres such as (PPF+HDPEF), (PPF+WPF), and (JF+WPF) to sulphate infected black cotton soil using silica fume significantly enhance the stress resistance properties.

6. The performance of hybrid fibre combination (PPF+HDPEF) is better than (PPF+WPF) and (JF+WPF) in enhancing the stress resistance properties of sulphate infected black cotton soil using silica fume as stabilization material.

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Review On Advanced Vibration Processing Techniques for Condition Monitoring in IC engines

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ABSTRACT

This paper deals with the strategies and techniques based on vibro acoustic signals that can monitor and diagnose faults in Internal Combustion Engines (ICEs) under both test bench and vehicle operating conditions. This technique can also be used to measure the amount of vibration produced in the IC engine during its working conditions. The vibrations themselves can then be used to measure the other faults in the engine. The ways to reduce the vibration signals are also elaborated. In recent years, several authors have summarized critical reviews mainly focused on general reciprocating machines. This paper focuses on specific signal processing techniques to deal with IC engine condition monitoring. Given the recent needs of the industry to

- optimize component durability and ensure long-life cycles,*
 - verify the engine's final status at the end of the assembly line,*
 - reduce the maintenance costs by monitoring the ICE life during vehicle operations;*
- A detailed review of Advanced Vibration Processing Techniques is much needed.*

Key-words: - *Artificial neural networks; Conditioning monitoring; Continuous Wavelet Transform Elastomer; Isolators; Order Analysis;*

I. INTRODUCTION

A remarkable amount of vibrations and shocks is produced in IC engines. If not handled properly, these vibrations may be harmful and decrease the engine's efficiency. The vibration condition monitoring deals with the effective reuse of vibrations. Based on the nature of vibration phenomena, the possibilities of usage of vibration become very wide. The vibration measurement procedure allows constant registration without invasion into the construction of the mechanism. These are non-destructive methods. Due to all these advantages and the challenging environment of the engine in transport, the application of vibration methods for engine monitoring systems has become very popular. If not managed properly, the vibrations in the engine may lead to hazardous accidents and, in turn, engine failure. It also reduces the engine's efficiency and increases the cost, including maintenance and repair. Thus management of vibrations plays a vital role in the IC engine. This paper contains some of the ways or techniques for condition monitoring of vibrations produced in IC engines. In some cases, there is also a need to reduce these vibrations by using cheap methods. These easy methods are also suggested here.



FIG. 1 -MULTI CYLINDER WATER COOLED ENGINE

2. Advanced Vibration Processing Techniques

2.1 Fault detection from vibration analysis:

Misalignment, unbalance, looseness, resonance, and other inaccuracies cause mechanical vibrations. Vibration signal involves signature information about the cause of vibration, and through its analysis using different methods developing faults are detected. When a fault develops, the signature of the collected vibration signal changes. Simple instruments to multichannel analysers are used to measure the vibrations. Various algorithms and methods are also used for the relationship between factors having the effect of vibration and a vibration signal.

2.2 Order Analysis:

Many other techniques are used to diagnose rolling elements and bearing faults, e.g. artificial neural networks (ANNs), fuzzy logic systems etc. According to the non-stationary characteristics of vibration signatures of roller bearing faults, a fault diagnosis method based on empirical mode decomposition (EMD) energy entropy has been presented by Yang et al.

Order analysis is a technique for analysing environmental and vibration signals in revolving or reciprocating machinery. Some examples of rotating or reciprocating machinery include aircraft and automotive engines, compressors, turbines, and pumps. Such machinery typically has various mechanical parts such as a shaft, bearing, gearbox, blade, coupling, and belt.

Order analysis is a type of analysis explicitly geared towards analysing rotating or reciprocating machinery and how frequencies change as the rotational speed of the machine changes.



FIGURE 2. VIBRATION ACCELERATOR TYPE 4368 LOCATION

2.3 Continuous Wavelet Transform

Continuous wavelet transform has some properties that make it better than other time-frequency techniques in analyzing impulsive signals, like diesel engine vibration signals. These properties are higher resolution and better localization characteristics.

The experiment was performed on the diesel engine to analyze by CWT, and results were noted. The analysis considered vibration data collected under four loads in operating conditions of 0 Nm, 20 Nm, 40 Nm, and 60 Nm. The engine was operated at a constant speed of 1000 rpm, and the exhaust valve clearance was changed from 0.4mm (Healthy condition) to 0.0 mm (Faulty condition). Then the engine operated under the same conditions at a speed of 1500 rpm.

From the (CWT) representation in fig2, it can be seen four peaks representing the combustion events of the engine cylinders in the firing frequency from left to right (1, 2, 4, and 3).

It shows that a significant part of the energy is located in the lower frequencies (below 5 kHz), and the peak of the CWT extends to around 35 kHz.

Fig. 3 represents CWT of the engine vibration signals for different loads and 1000rpm engine speed, the frequency with a crank angle at a healthy case and vibration amplitude in meters; as the load increases, vibration amplitude increases.

By changing the operation loads from 0 Nm to 20 Nm to 40 Nm to 60 Nm at two different speeds, 1000 rpm and 1500 rpm, with 0.4 clearance (healthy condition), the heights of the combustion peaks are proportional to the engine load and speed confirming that the engine vibration signals are load and speed dependent.

The main target of this study is to acquire accurate data from the engine test rig operating under normal and abnormal conditions and apply signal processing techniques for condition monitoring. To collect these signals, accelerometers (sensors) of various types are used. Only exhaust valve clearance faults were investigated. The results are shown below in fig 3.

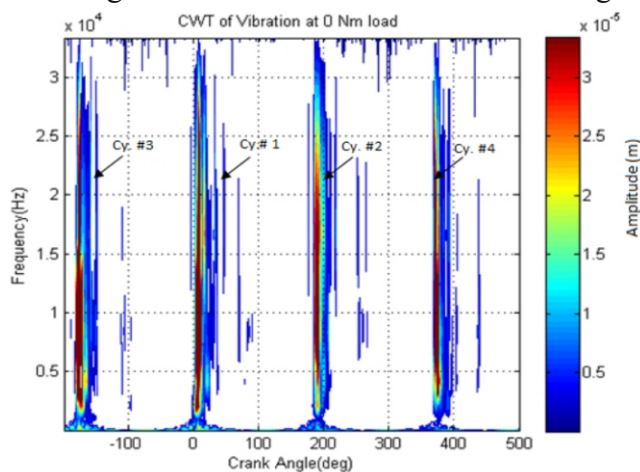


FIG 3- RELATION BETWEEN CRANK ANGLES, FREQUENCY, AMPLITUDE AND CWT OF VIBRATION

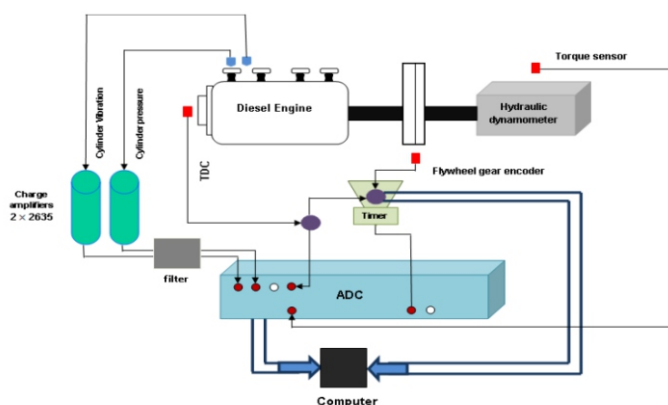


FIG.4 MONITORING SYSTEM AND WIRING DIAGRAM

3. Ways to Reduce Vibrations in IC Engine

Vibrations in an engine are never good, but they cannot be avoided. However, it can be reduced to a certain level. This can be done by analyzing three basic components

- o The equipment (any machine to be tested)
- o The supporting member (floor, base plate, concrete foundation, etc.)
- o The resilient member, like an isolator or mount (rubber pad, air column, spring, etc.), is placed between the equipment and the support structure.

If the equipment is the source of the vibration, the purpose of the isolator is to reduce the force transmitted from the equipment to the support structure. The direction of force transmission is from the equipment to the support structure. Vibration isolation is the process of separating an object, such as a piece of equipment, from the source of vibrations.

Active isolation: Active vibration isolation systems contain, along with the spring, a feedback circuit which consists of a sensor, a controller and an actuator.

Passive isolation: “Passive vibration isolation” refers to vibration isolation by passive techniques such as rubber pads or mechanical springs. Common passive isolation systems:

A. Mechanical springs and spring dampers

Helical coil springs are available in many different sizes and have load-carrying capabilities. These are heavy-duty isolators used for building systems and industry. Sometimes they serve as mounts for a concrete block, which provides further isolation.

B. Molded and bonded rubber and elastomeric isolators and mounts

These are often used as machinery mounts in vehicles. They absorb shock and reduce some vibration. Isolation mounts reduce energy transmission from one body to another by providing a resilient connection between them. Damping reduces vibration amplitude by converting a portion of the energy into low-grade heat. Anti-vibration Mounts (AVM) are the structures used to absorb the vibrations and dampen the harm causing forces. Mount result in a system which is modelled as mass/spring/damper. AVM consists of the rubber or elastomeric sandwiched between the metal cover plates. The ability of an elastomer to convert the energy of motion allows it to absorb vibration. Anti-vibration mounts are designed to isolate undesirable vibration generated in engine, industrial, consumer and scientific equipment. An anti-vibration mount achieves these aims by balancing out the system frequency with the disturbing frequency. An anti-vibration mount can actually absorb over half of the energy produced by the vibration.

C. Tuned mass dampers

Tuned mass dampers reduce the effects of harmonic vibration in buildings or other structures. A relatively small mass is attached in such a way that it can dampen out a very narrow band of vibration of the structure. The performance of an isolation system is determined by the transmissibility of the system, i.e. the ratio of the energy going into the system to the energy coming from the system.

D. Pads or sheets of flexible materials such as elastomers, rubber, cork, dense foam

Elastomer pads and laminate materials are often used under heavy machinery, typical household and laminate materials items, vehicles, and even higher-performing audio systems.

4. Conclusion

The paper deals with the use of vibrations that are formed in the IC engine. The vibrations are processed, and signals are formed, which help diagnose or identify faults in the IC engine. The general methodology is that the reference vibration signals of known frequency, amplitude, wavelength and magnitude are imparted on the component, and due to faults, changed vibration signals are recorded.

The other way is - that engine body vibration signatures are rich in information about its operating parameters and physical condition and could be measured by attaching an accelerometer to the engine block. This helps to find faults in the engine- Continuous Wavelet transform method is widely used in industries to note the faults that are about to occur. This method also helps to plot the graphs and to study results graphically. This method gives accurate results as compared to any other method. It has recent advancements and is widely used for predictive maintenance.

From the above isolations methods, vibrations in the IC engine are controlled to some extent. This gives better performance of engines and increased life of all engine components due to reduced vibrations. The above suggestions are some easy methods used to reduce vibration and noise.

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SOME PIONEER WOMEN OF ITALIAN CHEMISTRY

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ABSTRACT

With the aim of putting them as references to society and that they can serve as examples of overcoming to the rest of the women, this communication shows the biographies of some Italian women who were pioneers of Chemistry in their country, although their figures and their scientific work are not well known by society. They are, in alphabetical order, Emma Fenaroli, Lidia Monti, María Piazza, María Ragno and Caterina Rossi, who began their remarkable professional careers in the first decades of the 20th century. Of all of them, their main biographical data and the scientific work they developed during their lives are presented, emphasizing in a particular way those activities that most contributed to the current development of Chemistry in Italy. Several biographical notes are also given of a woman not born in that country, but in Russia, Maria Bakunin, who, due to her remarkable teaching and scientific work, developed entirely in Naples, can also be considered a pioneer of Italian chemistry. The methodology followed has consisted of searching different sources for all kinds of data on these women, trying to complete with them the very few biographies that can be found about them in the literature.

Keywords: *Women scientists; pioneers women of Italian chemistry; Emma Fenaroli; Lidia Monti; María Piazza; María Ragno; Caterina Rossi; María Bakunin.*

I. INTRODUCTION

As a general rule, there are not many women scientists around the world who lived and worked in times before the 20th century that society has any knowledge of, in part because they certainly were not too many, since the current laws of that time made it very difficult for women accessing higher education and later exercising their professions, and in part, above all, because of the gender difficulties that women have always suffered at that time, facilitated the fact that during their lives they were practically ignored, and that after their deaths, except in some special cases, not many either, no remnants of the memories of their lives or their actions were preserved. Do not forget that at the time in question, the role expected of women by society was only to take care of their family and their home, considering it inappropriate, even by some of them, to work in professions traditionally assigned to men. In this regard, this communication follows the path of several very similar previous ones by the author, presented at different congresses related to gender difficulties, aimed at bringing to light the biographies of these scientific women and putting them to society as what they truly are: models and references that all other women should know. It shows the biographies of the first Italian women to graduate in Chemistry and exercised their activity in that country on equal terms with their male colleagues. In alphabetical order, they were Emma Fenaroli, Lidia Monti, María Piazza, María Ragno and Catherine Rossi.

The structure of the communication is as follows: after exposing the objectives and the methodology followed, the results are indicated, on the one hand, the biographies of the five women mentioned above, all of them Italian women who practiced their profession in that country and who somehow, they laid the foundations, joint with their male colleagues, for Chemistry in Italy. On the other hand, with the aim of contextualizing the state of Italian Chemistry at that time, the biography of Maria Bakunin, a Russian woman, later nationalized Italian, is also shown. She also graduated in Chemistry in Italy and developed all her professional work in that country, being highly recognized for it by her peers but very little by society in general, because of the scant data available about her in the literature. A final section of conclusions ends the communication.

2. OBJECTIVES AND METHODOLOGY

The objective of the communication is to bring to light the most relevant biographical data of some of the first Italian women who graduated in Chemistry in that country and then began to practice their professions there, performing the same functions as their male colleagues, reaching some cases very relevant results, which have generally gone unnoticed, in order to put them all as models and referents for women in society.

The methodology used has consisted of searching for data on these women in different files, newspaper archives and bibliographical references, trying to complete with them the very few biographies that can be found about them in the literature.

3. RESULTS

The five parts of the first subsection of this section are dedicated to presenting, respectively and in alphabetical order, the profiles of the five women that appear in Table

1, all of them Italian and pioneers of Chemistry in that country. The second subsection shows the biography of another woman with a degree in Chemistry from the University of Naples at that time, the first decades of the 20th century, not Italian by birth (she was born in Russia), although she was in a natural way adopted, since she developed her entire brilliant career in the Italian country: Maria Bakunin

Table 1. Pioneer Italian. Source: Personal elaboration

Name	Year of birth	Undergraduate year	Undergraduate University	Year of death
Fenaroli, Emma	1886	1909	Pavia	1959
Monti, Lidia		1913	Rome	Post 1962
Piazza, María	1894	1916	Naples	1976
Ragno, María	1897	1923	Naples	1970
Rossi, Caterina	1890	1912	Florence	1966

3.1. Pioneer women of Italian Chemistry born in the country

This subsection shows the biographies of five Italian women who, due to the dates on which they graduated in Chemistry and due to their scientific activities at the time they were developed, can be considered pioneers of Chemistry in that country. In alphabetical order of surnames, they are Emma Fenaroli, Lidia Monti, María Piazza, María Ragno and Caterina Rossi.

3.1.1. Emma Fenaroli

Emma Fenaroli (de soltera Levi) nació en Turín el 24 de diciembre de 1886 y se licenció en Química en la Universidad de Pavía en 1909.

Emma Fenaroli (née Levi) was born in Turin on December 24, 1886 and graduated in Chemistry from the University of Pavia in 1909.

After starting her professional activity working at the Merck company in Milan, she married in 1912 Piero Fenaroli, specialized in Chemistry and military (he was lieutenant colonel), who had founded in Via San Vincenzo number 38 a research and analysis laboratory, the unique in Italy at that time, specialized in the study of essences, perfumes and soaps, to which other sectors such as glass, textiles and colors were later added. Due to that marriage, Emma Fenaroli converted to Catholicism.

From that moment, she began to collaborate intensely with her husband in the laboratory, although unfortunately, a few years after their marriage, her husband suffered an accident in the laboratory, poisoning himself with an asphyxiating gas (phosgene) and died in 1918, leaving three children still young.

Far from being discouraged by such a terrible loss, Emma Fenaroli was encouraged to continue working, although in 1919 she was forced to leave her workshop where she had been working with her husband, leaving it to her eldest son, and she devoted herself first to directing the journal of essences and perfumes, which had been created by Riccardo Subinaghi, one of the pioneers of the Italian essences industry and later to own it.

After becoming the owner of that journal, Emma Fenaroli worked for years on her aspiration to unite all Italian essential workers in a single society, which she finally achieved with the creation, on May 8, 1926, of the Italian Union of Producers of Aromatic Materials, based in Milan.

In 1936 she received a prize from the Italian Academy for her 17 years of activity in the field of essences and officinal plants, although two years later, in 1938 and due to racial laws, she was disqualified from the Italian Institute of the History of Chemistry in Rome.

That same year and due to the same racial laws, it was also forced to interrupt the publication of the New Journal of Vegetable Oils and Soaps, which merged with the Essence Journal, although first she had to relinquish responsibility for its management, which it resumed finally in 1945.

In 1949, she founded the “Italian Committee for Aesthetics and Cosmetology” and three years later, she also laid the foundations for the creation of the “School of Aesthetic Dermatology, Cosmetology and Skin Hygiene” in Milan, with programs approved by the Ministries of Education and Health and with specialized teachers in all the subjects that were taught in the different fields of education.

In 1950, Emma Fenaroli (Figure 1) created the “Italian Fragrance Foundation”, which joined the American Foundation of the same name, with the aim of promoting new applications and uses in the field of perfumery.



Figure 1. Emma Fenaroli. Source: (Scorrano, 2008, p. 502)

Other of her many later professional activities were her participation in the main European cosmetic and perfumery events, her appointment as an expert in professional education for estheticians by the International Committee of Aesthetics and Cosmetics and the organizations of the Congress of Aromatherapy in Milan of 1957 and of the International Congress of Aesthetics and Cosmetology also in Milan.

Emma Fenaroli died after great suffering on May 21, 1959, after having become for more than forty years a representative and organizational element of relevance in various sectors of her specialization such as essence, perfumery, herbalism and cosmetology (Rovesti, 2008, pp. 502-503).

3.1.2. Lidia Monti

After working for a time in industry, Lidia Monti graduated in Chemistry from the University of Rome in 1913.

Two years later, in 1915, she took over the management of the Municipal Chemical Laboratory of Rome and in 1917 she was called to direct the chemical laboratory that the Rossi Electrochemical Company had at its headquarters in Ponte Mammolo.

In 1925 she returned to Rome, to work at the Chemical Institute of her University and in 1927 she was appointed assistant professor in the chair of Aviation Materials Technology, directed by Professor Nicola Parravano.

After working as an assistant to Professor Luigi Bargellini at the Superior School of Malariology in 1930, she obtained the following year and on an interim basis the chair of Organic Chemistry, which was vacant at the University of Rome.

From 1934 she was in charge of teaching the Chemical Preparations Course at that University until in 1940, she obtained through competition the chair of Pharmaceutical and Toxicological Chemistry of the Faculty of Pharmacy of the University of Siena, in which she remained for more than twenty years, becoming its dean between 1958 and 1960.

In 1962 she was awarded the Gold Medal of Merit from the College of Culture and Art, for her dedication to teaching and research.

Within her intense scientific activity, her research on acridine, thiopyrimidine, quinazoline and quinoline derivatives deserves mention, as well as her studies on the action of nitrous vapors on organic substances and on the oxidizing action of selenium dioxide.

She died on June 4, 1993, after a long illness, at the age of 102 (Franchi, 2008, pp. 723-724).

3.1.3. María Piazza

María Piazza was born in Ariano Irpino, province of Avellino, on July 2, 1894, and graduated in Pure Chemistry at the University of Naples in 1916, after completing an experimental thesis with Professor Zapato. In 1925 she also graduated in Natural Sciences at the University of Rome, where she held the position of assistant for a few years (Linguerra, undated).

The beginning of the exercise of her profession was very varied. She first worked in the industry. Later, at the suggestion of Professor Tulio Tentori, she devoted herself to teaching, giving classes in various centers in Rome: the Tasso Lyceum, the E. Pimentel Fonseca Normal School and finally the EQ Visconti Institute-gymnasium, from 1929. During that period, she simultaneously taught with the studies of the Natural Sciences career and also dedicated herself to scientific research under the direction of Professor Federico Millosevich, from who she was assistant from 1926 to 1932.

During her work in the lyceums, she focused primarily on providing a good education for young women, a task to which she devoted all her knowledge and enthusiasm, especially in the Tasso, Visconti and Righi secondary schools in Rome.

From 1930 to 1937 she collaborated in the writing of the Italian Encyclopedia in the part of mineralogy and geology. However, in 1938, due to the racial laws that, promulgated by the fascist regime, deprived citizens of Jewish origin of civil and political rights, she was expelled from teaching, banned from university and expelled from the Italian Geological Society as well as the Italian Society for the Advancement of Sciences, of which she had been a member (Linguerra, undated),

From 1939 to 1943 he taught chemistry in Jewish schools attended by Jewish students who had been expelled from public schools. These were special secondary schools granted and controlled by the regime through an "Aryan" Commissioner, appointed directly by the Ministry of National Education. The one in Rome was organized in less than two months and was divided into an institute-gymnasium, a teaching institute and a technical institute with a commercial address.

Although the school was parastatal, the students attended it at the risk of their personal safety, being constantly threatened by the actions of the fascist squads. Both professors who had lost their professorships, including Maria Piazza herself and Emma Castelnuovo, and some brave Aryan teachers in solidarity with their Jewish colleagues were recruited as teachers. The headquarters of the school, inaugurated in December 1938, was a building located in via Celimontana, near the Colosseum. In 1940-41 the center had to move to the facilities of the Jewish Asylum located at no. 13 Lungo Tevere Sanzio, a few steps from the special court organized by the regime to monitor citizens.

María Piazza (Figure 2) also lived the experience of the so-called "clandestine Jewish university". After completing high school, in fact, not only were Jewish students prohibited from enrolling in public universities, but the Jewish community was also prohibited from instituting private university courses. In December 1941, under the fictitious name of "Integrating Courses in Mathematical Culture", she opened a true university "outside the law" which was in operation for the following two years, until the liberation of the capital, and in which she stood out as expert teacher and claimant.

She also worked in the Chemical Society, and in particular in the Section of Lazio, Abruzzi and Umbria, of whose Council she was a member of the Council, contributing her personal activity to improving the problem of chemists who taught in secondary schools and technical institutes.



Figure 2. María Piazza. Source: (Scorrano, 2008, p. 659)

Appointed Commander of Merit of the Republic, María Piazza died suddenly in Rome on April 27, 1976 (Marini-Bettolo, 2008, p. 659).

3.1.4. María Ragno

Born in Naples on November 30, 1897, Maria Ragno graduated in Pure Chemistry in 1923 at the University of Naples and then went on to practice her profession working as an analyst at the Bauxite Company.

In 1928 she was appointed civil servant and soon after director of the Office of Surveys and Statistics of the National Federation of Chemists. In 1930, that Federation commissioned her to write the first edition of the "Yearbook of the Chemical Industry".

In the following years she also devoted herself to writing two monographs: "The soap industry in Italy and abroad" and "The Italian industry of colors and paints", which were published, respectively, in 1936 and 1938.

In 1945, María Ragno (Figure 3) founded the publishing house "TecnindustriaEditrice" for the publication of the "Chemical Industry Directory", a very useful collection of data related to products and manufacturing industries, which was published for the first time in 1949 and was updated every two years. In 1949 she also founded the publication "RassegnaChimica", a magazine that had considerable success, especially in the sectors of basic products and applied chemistry.



Figure 3. María Ragno. Source: (Scorrano, 2008, p. 625)

She was one of the Chemistry graduates who founded the National Union of Italian Chemists (UNCI) in 1954, holding a position on its Board of Directors from the very beginning. One of her functions in that society was to create and promote the Chemical Equipment Exhibition, which has taken place every year since 1961.

In 1947 she published an article titled (in Italian) "L' industriachimicaitaliananei due dopoguerra 1914-18 e 1939-45" in the journal "L' Industria: rivista di economia e politicaindustrial"

Two days before her death, which occurred on November 30, 1970, the National Union of Italian Chemists, at its Assembly of Members held in Genoa, named her an Honorary Member for her work and merits acquired in that society. (Scorrone, 2008, p. 625).

3.1.5. Caterina Rossi

Born in Florence on March 3, 1890, Caterina Rossi graduated in Pure Chemistry from the University of her city in 1912, with the highest marks. That same year she obtained a master's degree in Chemistry at the Institute of Higher Studies and in the academic year 1912-13 she obtained the diploma corresponding to the specialization course.

From 1913 to 1917 she was a chemistry teacher in several secondary schools in Florence and in 1917, after leaving teaching, she devoted herself to industry when she was hired to direct the analytical laboratories of the chemical and pharmaceutical industry "Molteni", with the assignment particular to carry out experimental research for the synthesis of organic drugs. In that period, she published two works, one on the oximes of santonin and the other on the polymers of isosafrole.

In 1924, Caterina Rossi moved to Milan to coordinate the Proceedings of the National Congress of Industrial Chemistry, held in that city in April of that year, and became a technical collaborator of the Industrial and Applied Chemistry Journal (later called, in 1935, Chemistry and Industry), a position she held until her death.

In 1926, Caterina Rossi (Figure 4) returned to teaching after winning the competition for the teaching of Chemistry and raw materials at the Commercial and Technical Institutes for Topographers, so that year she moved to Camerino, where she remained until 1928, then passing to Ravenna and already, at the end of 1934, to Pavia.

In 1942 she moved to the “Italo Balbo” Industrial Technical Institute for Chemists and then to the “Ettore Molinari” Scientific High School in Milan, also working as a teacher in the department of General Chemistry, Chemical Analysis, Physical Chemistry and Electrochemistry, where she remained until her retirement on October 1, 1960, although after retiring and at the request of the dean of the Institute, she spent one more year working without being paid for her services.



Figure 4. Caterina Rossi. Source: (Scorrano, 2008, p. 580)

During her teaching activity she made a valuable contribution to the publishing sector by writing several Chemistry textbooks for secondary schools (in her own language). Among them, the following two can be highlighted (Figure 5)

- Elementi di merceologia per la terza classe industriale femminile. Carlo Signorelli Editore, 1931.
- Chimica per gli Istituti Industriali. Editore: Libreria Yelets, 1952.

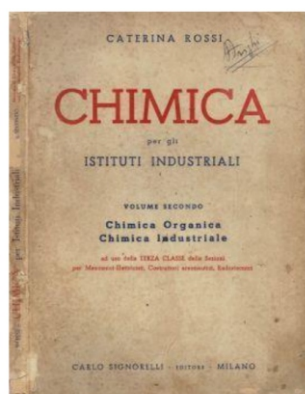


Figure 5. Cover of one of the books written by Caterina Rossi. Source: Livri Vintag

Interestingly, in the first of them, entitled in English "Elements of merchandise for the third industrial class of women", Caterina Rossi deals with a not well-known science, Merceology, which studies the nature or origin, composition or function of all the movable things susceptible or not of commerce and according to it, their classification, also taking charge of the knowledge of impurities and falsifications, and of the methods to recognize them. The second, "Chemistry for Industrial Institutes", is already more typical of her profession.

Caterina Rossi passed away on March 5, 1966 (Giuffrè, 2008, p. 580).

3.2. María Bakunin

María Bakunin was born on February 2, 1873, in Krasnoyarsk (Siberia). She was the third daughter of the marriage that formed the Russian revolutionary philosopher Mikhail Bakunin and her Polish wife Antonia Kwiatkowska. Her older brothers were Carlo and Sofia (Anonymous, 2019). María was also the aunt of the famous mathematician Renato Caccioppoli (Naples, 1904-1959), son of her sister Sofia. Some sources indicate that in 1938 her nephew Renato was imprisoned after publicly delivering a speech against Hitler, Mussolini and the fascism, on the occasion of the former's visit to Naples. Renato was not only satisfied with making that speech, but also hired an orchestra to play La Marseillaise. Fortunately for him, María Bakunin was able to obtain his release by convincing the judges that Renato did not know what he was doing due to he was insane, for which he was admitted to a psychiatric hospital (Ciardi, Focaccia, 2011). To obtain this release, María Bakunin had to argue in court that despite fascism's ban against men walking small dogs (to safeguard their virility), Renato used to walk the streets of Naples with a rooster with collar and leash (Anonymous, 2019).

And as for her father, Mikhail Bakunin (1814 – 1876, this was a Russian anarchist thinker and activist, socialist, main ideologue and founder of collectivist anarchism. He is considered one of the most influential figures of anarchism and one of the main founders of the revolutionary socialist and anarchist tradition. Their thought is summed up in the suppression of classes and private property, along with the need to promote revolutionary acts to end the social fabric. Their revolutionary character was decisive between the Russian nihilists and the Catalan and Italian anarchist movement. "God and State", his most important work, was not published until 1882 (Fernández y Tamaro, undated).

Despite her birth in Russia, María Bakunin lived from a very young age in Italy, a country where she acquired all her cultural and scientific training. The whole family had moved to Naples after the father's death in Bern, being welcomed by the socialist lawyer Carlo Gambuzzi, a close friend of the deceased, who took care of all the family's needs, also marrying the Bakunin's widow a little later, although María Bakunin did not obtain Italian nationality until 1946 (Anonymous, 2019).

The lawyer's house was a true cultural and political center, in which great ideals of freedom were breathed and individual stimuli were favored, so María Bakunin and her brothers were able to go to the best schools in the city.

Already in her university student stage, she was a "preparator" in the chemical laboratory of the Federico II University in Naples, where in 1895 she graduated in Chemistry with a thesis in stereochemistry, also receiving the Academy Award for it. of Physics and Mathematics of Naples in 1900.

After graduating and less than twenty years old, she began her academic career as a professor at the Institute of General Chemistry, directed by Professor Agustín Oglialoro Todaro, whom she married, although she never had children. In 1903 she was hired as a professor of Applied Chemistry at the Faculty of Engineering, later converted into the Higher Polytechnic School of Naples

The following year she worked as a professor of technological organic chemistry at the same school, where she became professor by competition in 1912. She held that position until 1940, when she asked to be transferred to the Chair of Organic Chemistry at the Faculty of Sciences of the University of Naples, where she remained until her retirement.

In 1906, Maria Bakunin was part of a research team studying the eruption of Mount Vesuvius, and in 1909 she compiled a geological map of Italy. As part of the project, she studied oil shale and ichthyolitic deposits in the mountains in the Salerno area. Following this, from 1911 to 1930, Bakunin worked as an advisor to companies and local governments interested in the industrial development of ichthyol mines in the Giffoni district of the Picentine Mountains (Nicolau, 2004).

In 1914, the Minister of Agriculture, Industry and Commerce, Nitti, commissioned her to study at the professional schools of Belgium and Switzerland, considered at the time to be at the forefront of teaching methods. Maria Bakunin noted with bitterness the existence of differentiated education for men and women. To solve the problem of Italian schooling, she asserted with determination that it should be the rich who pay, through taxes, for the education of the poor.

Likewise, in 1935, she traveled to Russia to officially participate in the congress that was held in that country on the occasion of Mendelejeff's centenary, taking advantage of her stay to carry out a survey on the state of the cellulose industry in some South American countries.



Figure6. María Bakunin. Source: (Nicolau, 2004)

At the end of World War II, Maria Bakunin (Figure 6) worked with Benedetto Croce to rebuild the Pontanian Academy, and in 1944 she was elected its president, a position she held until 1949. One of her tasks was the restoration of the Academy Library (Nicolau, 2004). Remember that Benedetto Croce (Pescasseroli, 1866 - Naples, 1952), an Italian writer, philosopher, historian and politician, was a leading figure in liberalism, whose work influenced Italian thinkers as diverse as the Marxist Antonio Gramsci, the fascist Giovanni Gentile or the Liberal Piero Gobetti. He is an author closely linked to Hispanic culture.

Her scientific activity was highly appreciated and recognized by different entities. She was a correspondent member of the Academia dei Lincei, an ordinary member of the Society of Sciences, Letters and Arts, of the Pontaniana Academy and of the Development Society. In addition to holding the presidency of the Pontanian Academy, between 1944 and 1949, she was also president of the Section of Physical and Mathematical Sciences of the Society of Sciences, Letters and Arts, between 1932 and 1952.

Regarding her scientific activity and research, Maria Bakunin published her first work in 1890, when she was only 17 years old, referring to the preparation of phenylnitrocinnamic acids.

This would be followed by more than 100 subsequent publications related to her two research lines under study, the Perkin synthesis mechanism and the isomerism of the compounds of the cinnamic series, paying special attention to the most suitable conditions for the transformation of ones into the others.

In 1900, at the age of 27 and competing with none other than E. Erlenmeyer, she won a Stereochemistry prize sponsored by the Academy of Physical and Mathematical Sciences (German chemist Richard August Carl Emil Erlenmeyer, known simply as Emil Erlenmeyer (1825 - 1909), was a professor at the Polytechnic Institute of Munich between 1863 and 1883. His most notable achievements were the synthesis of guanidine and tyrosine, as well as the explanation of the structure of compounds such as lactone. He is also well known for the flask of precipitates that bears his name).

In the very detailed report by the jury at the time of awarding that prize, in which the reasons why it had been awarded were fully explained, the following was said:

Mrs. Dr. Maria Bakunin presents 6 reports on stereoisomers of phenylcinnamic, phenylnitrocinnamic and phenyloxycinnamic acids and their derivatives, published between 1895 and 1901. They are the result of assiduous, clear and intelligent experimental work. The first article on the numerous compounds of three stereoisomeric pairs of nitrocinnamic acids are carefully described and a thorough knowledge of the subject is manifested. In the second, the transformation of halocomposites into those and their behavior in different reactions is studied. The third describes the stereoisomer of phenylcinnamic acid, already tried in vain to prepare by other chemists. In the fourth, the non-existence of an oxyphenylcinnamic acid, which Vandavelde believed he had achieved, is demonstrated with impeccable experience. In the fifth, the constitution of phenylnitrocinnamic acids is discussed and it is established that it belongs to the planosymmetric formula, to which the axial formula belongs, the indones corresponding to these acids are prepared, and a new method of dehydration of organic bodies is shown. based on the use of phosphoric anhydride in bodies dissolved in neutral solvent. Finally, in the sixth memory, the author deals with this new dehydration process, showing, with numerous experiences, its advantages.

From what we have briefly explained, Mrs. Bakunin, through assiduous experimental work, rich in new data, overcoming not a few difficulties, has clarified a chapter of stereochemistry and has made a not insignificant contribution to the progress of this part of Chemistry.

Therefore, the Physical Sciences Section proposes that the prize of one thousand lire be awarded to Dr. Maria Bakunin

Estanislao Cannizzaro and Emanuele Paternó, speakers.

In addition to these fundamental studies, Maria Bakunin also carried out others on the Zincke synthesis, on the constitution of picrotoxin, on the esterification of phenols and on the catalytic action of some colloidal solutions in organic synthesis.

Moreover, her studies on shales and bituminous oils made interesting contributions in the field of applied chemistry and led to the preparation of important pharmacological products, obtained by sulfonation of distilled oils.

Apart from her research work, Maria Bakunin carried out an important teaching activity, which greatly contributed to achieving the efficiency of the Neapolitan chemical institutes, either by favoring the immediate and extraordinary understanding of the continuous evolution of studies, or by educating a large crowd of students, many of whom reached prominent positions in life (remember, as an example, the later relevance reached by her favorite student, Francesco Giordani), or by transmitting to her closest entourage her love for research, the rigor of scientific work well made and, above all, the fundamental virtues of conscientiousness and concern.

From a personal point of view, Maria Bakunin, better known as Marussia Bakunin or, generally by "the Lady", as everyone designated her (Figure 7), was essentially a woman of great righteousness, who at all times had the cult of God intact. sincere and deep friendship. She was always extraordinarily strict with the students and with herself, with the aim of getting the most out of the young chemists and the formation of a strong professional conscience.



Figure 7. Maria Bakunin. Source: (Scorrano, 2008, p. 511)

Although she never defined herself as an anarchist, unlike her father, Maria Bakunin had a strong and generous character and a great sense of justice, good human qualities and great courage in abundance that she manifested at all times. As anecdotes of her life the following are told (Anonymous, 2021)

Riding in a carriage along Via Toledo in Naples, she had to tame the raging horse. On another occasion, she saved her sister Sofia, who had fallen into a well, by lowering herself with a rope and grabbing her by the hair.

During fascism, she refused to have a child, appearing for chemistry exams dressed as a soldier, despite the decree of the authorities that ordered all soldiers to have children. She was saved only thanks to the providential intervention of her husband.

Also, when the Germans burned down the university libraries, she sat near the flames with her arms crossed. The German commander, surprised by the gesture, gave the order to withdraw and the damage was limited. It was precisely for this gesture that the aforementioned Benedetto Croce proposed her in 1944 to preside over the Pontian Academy, a long-standing cultural association that had been suppressed by the fascist government.

During the war she was also responsible for rescuing the Chemical Institute from German reprisals and the aftermath of Allied occupation, also paying the price of having her house burned down in an act of retaliation against the Neapolitan University.

Her house in via Mezzocannone, where she welcomed innumerable cats, was for many years and until the end, a meeting place and a place of welcome for exponents of the cultural world, for the persecuted and for refugees.

Maria Bakunin died at the age of 87, in her beloved Naples, the city where she spent practically her entire life, which, together with her remarkable scientific work, makes her worthy of appearing as one of the first relevant women in Chemistry Italian, despite not having been born in that country (Nicolaus, 2008, pp. 511-512).

In Naples, there is a plaque in her memory at the door of the University's Faculty of Chemistry and a promenade in the outskirts also bears her name.

In Figure 8, she can be seen, dressed in a wide long skirt, mantilla and hat, as the only woman who was part of the large group of Chemistry graduates who attended, in 1896, at the age of 23, the meeting held in tribute to the 70th anniversary of the illustrious chemist Stanislao Cannizzaro (Palermo, 1826 – Rome, 1910), recognized by all as the master of Italian Chemistry.

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In this regard and considering it of value, let us collect the verbatim phrases that Scorrano wrote in his work "La Chimica italiana" in recognition of the scientific work of Professor Cannizzaro (Scorrano, 2008, p. 23):

To understand and appreciate the greatness of her work, it is necessary to consider the conditions of Chemistry in the first half of the last century, when everything was dark in the minds of chemists, even the greatest. In her famous "Sunto", Cannizzaro demonstrated the need to assume Avogadro's hypothesis as the foundation of atomic theory. The atomic weights obtained by applying herrule, among other things, allowed Mendeleeff to establish his periodic system. The tetravalence of carbon that [Cannizzaro] confirmed also provided a solid foundation for Organic Chemistry.

With reference to the above, remember that Stanislao Cannizzaro was appointed Professor of Chemistry at the University of Genoa in October 1855 and there he continued his work on aromatic alcohols, such as benzyl alcohol, which he obtained from the respective aldehydes, together with the corresponding acids, by means of a reaction currently known as the "Cannizzaro reaction". During his stay in Genoa he published, in addition to the experimental works, his famous "Summary of a Course in Chemical Philosophy" (known as Cannizzaro's "Sunto"), which was published in the prestigious magazine "Nuovo Cimento" in 1858, in which he shows that reaction, which allows the choice of the atomic weight, a reaction later known in the chemical field as the "Cannizzaro reaction", also called the "law of atoms".



Figure 8. Maria Bakunin in 1896, only woman, last on the right, at the 70th anniversary meeting of Professor Cannizzaro. Source: (Scorrano, 2008, portada)

4. Conclusions

From the research carried out, it can be deduced, without the slightest hint of a doubt, that all the women who appear in this communication can and should be considered as true models and references to society in general and to Italian women in particular, since, not in vain, all of them performed the same functions that current women chemists perform today, despite the fact that at the time of their degrees the role of women in society was not considered relevant at all, limiting themselves only to the care of the home and of the family. However, these women managed to overcome all the difficulties that arose to be able to graduate in Chemistry and then practice their professions in a completely similar way to that of their male colleagues.

Thus, it can be noted that Emma Fenaroli created and directed magazines on essences and perfumes and founded several institutions, such as the Italian Union of Producers of Aromatic Materials, the Italian Committee for Aesthetics and Cosmetology, the School of Aesthetic Dermatology, Cosmetology and Skin Hygiene. and the Italian Fragrance Foundation, thus being one of the pioneering women in the field of Italian perfumery.

For her part, Lidia Monti was awarded the Gold Medal of Merit from the College of Culture and Art, for her dedication to teaching and research, and María Piazza was appointed Commander of Merit of the Republic, for her outstanding Teaching work.

María Ragno, founder of a publishing house and one of the promoters of the creation of the National Union of Italian Chemists, was named Honorary Member of that entity for her work and merits acquired in it, and Caterina Rossi, professor of Chemistry at several secondary schools in Florence, also devoted herself to industry and research.

And what say about Maria Bakunin, without a doubt the woman with the most brilliant resume of those cited in this communication due to her merits. Teacher, researcher, in Italy and abroad, author of numerous publications, winner of several prizes and distinctions, and founder and president of several prestigious Italian chemical institutions, her work, together with that of the other women mentioned above, allowed to open the door for other women to follow that path later and contribute equally with their work to the enormous development that Italian chemistry has today.

Hence, it is very fair that all of them can be considered true references to society.

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HETROGENEOUS APPROACH IN NATION BUILDING

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ABSTRACT

Nations live together when the occupants share a delicious number of values and tendencies and can joke with each other. Uniformity among peoples may be served with titles, showing a common language, and forming the initial stage for a more clear journey, yet in addition to wild power, for example, rejecting the social orders of the neighborhood or In any event, flutter. Striking governance bodies and oppressive regimes have different invigorating skills related to choosing how and by what means to make everyone equal. We study and take a look at the two designs, and change in large part from abuse moves government to a model where the size of countries and the degree of dynamic homogeneity are endogenous. We present some candid discussion of some episodes that show our speculative results.

1. Introduction

Country checks could potentially go as an asset to this alternative technology. We understand it here as a way to (re)define a place for the nation and the people to elevate the country in new assemblies. We view country inquiry as a "proper development" of nation building, which explores how open characters are created and communicated. Country making at any rate suggests a local cycle in a general sense in which political elites (or state-systematic experts) try to overcome the previously common, ethnic, etymological, Or severe divestment, country enterprise is a somewhat coordinated business venture originally intended to "sell" the nation by attracting new cash-related associates or explorers. Regardless, especially for smaller grants that require military endpoints, the launch of the express open character in-country checks and overseas has likewise received praise for achieving overall infrastructure goals or in everything organizations consider. Nation enterprise structures, in any case, apart from the neighborhood effect, as they can be used by the states to instill pride in the nation and hence further social unity. Viewed from a more fundamental point of view, country checks can be used by law making bodies for closer cover. By explicitly linking government plans to public characters and interests, political enemies can be emancipated as the untouchables, who clearly do not have the flourishing country with the most central level.

Even though the approaches to nation building and nation checking are open to all countries at a fundamental level, we declare that the important avenues and expected benefits of such processes are clearly defined on the fixed, piecemeal, social and cashrelated conditions of the countries.

For countries with edge heritage, heterogeneous social systems, and weak financial foundations from a holistic perspective, country investigation may be promising – and perhaps necessary – to advance the progress of the country as well as political open doors and public characters. . Clearly, in such circumstances, of course, the common entry way to country building is definitely going to be restricted, bearing in mind that there is hardly a (certain) way to share public character and pride. be security. In addition, the scrutiny of possible entry routes into the country is similarly restricted when new cash into a country does not pose a wonderful temptation to partners or travelers. Necessarily, such friendly orders should be clear as "truth marks" to participate in country building and the nation check may be "total insane" to carry out such strategies anyway. The result may be that undertakings in the country's investigations may fail to appear even under surprisingly dire circumstances.

In the hopes of inspiring public characters, country building seeks to reduce or kill past ethnic, expressive, or serious characters that are perceived to be entangled with public identity. 8 Nation building can take a number of plans, including creating an approach or setting aside cash to make fundamental development progress.

As they continued to seek country building, the political elite could examine different strategies. Other obvious (and reliably rather shallow) techniques can be the creation of public banners, melodies, programs or sports. These motives of the id may undoubtedly promote the influence of the public figure and power, yet without the aid of another person they seem to lack any touch of any of the fundamental energy of shared nationalism. If in any case, country building is seen as a much lengthy and trialed effort, then a really necessary and necessary system is needed.

Country building systems of that kind usually revolved around training, to guarantee that another era gives close to language, an indistinguishable beginning of public history, and for public legends and social images in common.

Even if such structures have no apparent short term impact, the true understanding of countries such as France suggests that their longer effects should be viewed calmly. Here the political top notch consistently won in its push to change ethnically, phonetically, and utterly split into a single originally bound country.

HETROGENEOUS APPROACH IN NATION BUILDING

Almost gigantic, entrepreneurship is likewise a contraption for configuration honor and public pride in the country; thus it also has a sensible area part. This is where the nation check coexists with - or should it be seen as a correction - the country is working, given that emotion and symbolism are major parts of the pack in the two techniques. Thus, the enterprise of the country is not just about being manifested but an asset to be used in the politico-philosophical mission to build a country. Such opinion checks in the country are linked, notwithstanding, money-related issues.

As has been suggested so far, the extent to which local authority issues, country building and the nation enterprise process can be used to pacify enemies or cover up security from political construction. This is the beginning and the end, except for one incident in which many post-explorer states have worked with winning party structures that appeal to entryway pioneers in short post-opportunity time frames, whose standards are normally consistent. The tyrant, and the rascal, would be as their terms.

Long hours in the office ended. In any event the trailblazer, to the degree achieved in favor of establishing a relationship of different nationalities among their common networks, was a huge expense a large part of the time paid for with regard to majoritarianism-based pluralism. Especially like country delivery, the line between country enterprise and receptivity is also notably slight. Therefore, country enterprise may be based on outdoor social events, usually for cash-related purposes anyway locally to help the alternative fivestar comfortably.

Opposing the fundamental possibility of Root redesigns of a non-greater part rule framework (and a large part support structure drives) are novel. A majoritarian government may choose public goods and systems that differ from the tendency of the ruler or five star, which may remain part of how many people run the government in the new large part. Along these lines, a clarity-based vote can separate everyone in more than one country. Taking everything into account, rules based do not form the most preferred scheme of the choice group.

The condition of democratization prompts the ruler to be homogeneous for two obvious reasons. In any case, educating and educating, by foolproof methods, a piece of time, grant those in charge to remain more likely about the standard (leaning their methods and a more specific country) whether the vote-based structure wins. . Second, greater homogenization, if it consistently lessens hatred for the government, may reduce everyone's motivation to kill the ruler. In additional surprising words: the rulers who compromised the root would give the people to help them "appreciate" the coherent framework.

An additional homogenous people can better surrender and support shared goals, managing the possibility of coordination in a resistance effort. This effect kills the various triggers of the ruler to make it homogeneous. This is a kind of "opening and reigning" effect. For this ongoing situation, and only for this ongoing situation, a ruler could choose to cultivate diversity in everyone.

We fight that colonists, rulers who face little prospect, and rulers with bound state borders will undoubtedly undertake processes that increase the diversity of all. Therefore, the delayed result of the "divide and rule" processes performed by the previous colonists could certainly be the fault of the states which were the previous settlements.

The riskiest approach to homogenization is building roads (or rail lines or air terminals) to reduce the cost of distance from the capital. It works with the approval of resources or living with the affiliation introduced in the capital, reducing the cash-related detachment. The latter comprehension is one of correspondence related to language. Imagine that the further away a person is from public authority, the more different his language. Decreasing distance for this ongoing situation can be interpreted as showing a specific language (according to the actual perspective, reducing the distance between tongues) so that individuals can speak faster at any time with public power and reach public affiliation.

At the same time that vote-based structures are less likely, a "secure" ruler has an irrelevant dominant force to equalize. A protected ruler has his own ideal government, has little risk of being dismembered, and is not concerned with general government support, so he is limited by the diversity of all as a whole. On the other hand, a large part drives the framework of uniformity to deal with the help of the public power of the people on the fringes. Thereafter a vote based structure is more nations functioning than a secure non large part rule framework. Of course, when a vote-based structure is more likely, a "dangerous" ruler under clear limits will embrace a much more necessary degree of uniformity than a government directing by a large majority.

Colonists clearly do not equate to near oppression or the recently surveyed five-star. Colonists leave the country after construction collapses. Then consider the three goals of symmetry achieved by the model. Since the colonist can't gather the energy to repeatedly think about what will happen to the country after he leaves, he won't pay the cost of homogenizing everyone to stay aware of the same old thing, if a democratic government wins.

As such the dominant trend to think potentially relevant to the colonizer links symmetry to reduce protection from colonization formation, and negative symmetry to reduce the extent to which everyone acts collectively to settle the colony. At a very basic level, homogenization can significantly reduce everyone's ability to remove colonizers.

Discussion

From the par excellence of colonized territories with colonized populations, systems of opening and control can be traced in particular, as it is possible that segregation and governance as a whole are justified and make progress from colonialism less inclined. Thus, ethnic conflicts and divisions within nations may intensify after dissolution.

Under clear limits, a ruler would strive for uniformity in period in order to abstain from severance and confirm that his ideal government proceeds in period; with almost no homogenization by the ruler, the popularity-based government in Period would choose chambers keeping an eye on less homogenization, division, and outright shocking tendencies from the rulers.

A popularity-based government allocates resources to homogenization until the best point for the middle voter. A ruler has a more grassroots propensity for his ideal government, leaning from the middle leaning towards a specific government in a vote-based structure. Such an unstable non-large-part rule structure (i.e. one with a high chance of democratization) can divert resources from a large-part system to a deviant homogenization to ensure that the system's ideal government is more than a vote-based system.

Again, under a stable non-vote-based structure, a ruler pools resources in a row, standing apart from a popularity-based government, as he wants to stay in power for the next term, thus his ideal in any case. The government is protected.

Homogenization is important not only in influencing the outcome expected victory of a large part lead structure, but also in the possibility of vote-based change being justified. By building the structure a ruler can further develop conditions and reduce the isolation of minority packs at cutoff points, thus reducing protection from the permanent system. Through teaching, non-large-part rule assemblies can create cutting-edges to reason in their own distinctive way. On the futile result of homogenization, the congregation can reduce conflict through the restriction or expulsion of express people and sociability.

Conclusion

A basic idea in executing country building blueprints or separation and rule techniques is the control of the state border. Symmetry may require a higher state threshold, for example, requiring a state foundation for the execution of a direction critical to all youth. A ruler with a reduced state limit may be restricted or unsuitable for homogenization. On the other hand, the parcel-and-rules approach may require different properties, lower state limits, and is in all likelihood going to be more reasonable in all honesty.

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