

Strength and Durability Research on Concrete with Partial Replacement of Cement by Rice Husk Ash and Spent Bleaching Earth

G Lalitha Devi, K Srinivasa Pasad, M Swaroopa Rani, L Bhanu

Abstract— Concrete is the foremost building material in the region of the sphere and used in operational works, including infrastructure, low and high-rise buildings. Substitution of waste materials will conserve dwindling resources, and will avoid the environmental and ecological damages caused by quarrying and exploitation of the raw materials for making cement. So we are interested in replacement of cement with waste materials coming from oil industry and rice mill industry. So we are taking spent bleach earth (SBE) from oil industry & rice husk ash (RHA) from rice milling industry. W/c ratio as 0.38 and SP 430 IS used for obtaining required slump. The required slump is arrived at 0.7% of admixture. Following replacing the Cement with SBE 5%, 7.5%, 10% and RHA with 2%, 4%, 6%, 8%, 10% aimed at optimum results. Now SBE5% & RHA 8% got optimum values. Subsequently beams, cylinders, cubes are casted. Compressive strength, Split tensile strength, Flexural strength originate for 7 days & 28 days. Later 28 days curing cubes are placed in Hydrochloric acid (HCL) for durability test. For durability test cubes are submerged in 5% of HCL for additional 28days & find the Compression strength.

Index Terms— Compressive strength, HCl, RHA, SBE.

I. INTRODUCTION

The use of business and agricultural wastes as supplementary materials in concrete production is changing into common and attracting attention of the many researchers. Spent mud and rice husk ash area unit waste materials arising from process of extraction of oil from feather palm dotty.

Spent mud (SBE) may be a solid waste generated in edible oil business. because of the high oil content within the compass point, its disposal will cause environmental hazards, since it's susceptible to catching fireplace, besides polluting the bottom water. With the restrictive restrictions in situ in most countries, the requirement to reduce the environmental impact is of growing importance and concern to the trade. sometimes compass point is disposed of in landfills or waste dumps

Rice husk ash (RHA) is associate cultivated primarily

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based pozzolanic material, created by rice mills in large quantities. therein eightieth of rice and two hundredth of husk was found throughout edge of paddy. This husk is employed as fuel in industries to get steams and alternative functions. This husk holds concerning seventy five nada organic fickle material and also the lasting twenty five you look after the load of this husk is reworked into ash throughout the firing method, this ash is thought as RHA.

However, the performance of concrete made with blended cement-SBE and RHA concrete in acidic environment has not been reported. Therefore, the thrust of this project is to investigate the engineering properties and effect of hydrochloric acid on the strength of the concrete in which cement is partially replaced by SBE and RHA.

II. MATERIALS USED

Ordinary Portland cement was used for the present study. Rice husk ash and spent bleaching earth obtained from local industries is sieved through 90 microns sieve. It is used to replace cement partially. The chemical composition of cement, RHA and SBE are tested. River sand and granite of maximum nominal sizes of 3.18 mm and 20 mm were used as fine and coarse aggregate respectively. Potable water was used for mixing. The Hydrochloric acid is taken from the scientific laboratory through civil engineering department and different concentrations of its solution are prepared in the laboratory.

III. METHODOLOGY

Concrete mix proportion of 1:1.74:3.06 (cement/RHA/SBE: sand: Coarse aggregate) is batched by weight. Cement is replaced with RHA in the proportions of 2, 4, 6, 8 and 10% of the weight of cement and SBE in proportions of 5, 7.5 and 10% of weight of cement are use. Seventy two concrete cubes of sizes 150x150 mm, Twenty eight Cylinders 150x300mm and Twenty four beams 150x150x700mm are cast and cured for 28 days in water. After 28 days some cubes are removed from water and immersed in Hydrochloric acid (HCL) solutions of 5% concentration for another 28days. On expiry of each curing age, cubes are tested for compressive strength.

IV. MATERIAL PROPERTIES

A. Cement

Table I Physical properties of cement

S.No	Property	Test results
1	Normal consistency	30%
2	Specific gravity	3.15
3	Initial setting time	95 min
4	Final setting time	205 min
5	Fineness	4%

B. Fine Aggregates

Table II Physical properties of Fine Aggregates

S.No	Property	Test result
1	Specific Gravity	2.54
2	Fineness Modulus	2.642
3	Bulk Density in loose state	1578 kg/m ³
4	Bulk Density in compact state	1718 kg/m ³
5	Grading	Zone II

C. Coarse Aggregates

Table III Physical properties of Fine Aggregates

S.No	Property	Test result
1	Specific Gravity	2.73
2	Fineness Modulus	6.02
3	Bulk Density in loose state	1422 Kg/m ³
4	Bulk Density in compact state	1555 kg/m ³
5	Nominal maximum size	20 mm

D. Rice Husk Ash (RHA) & Spent Bleach Earth (SBE)

Table IV Physical properties of RHA & SBE

S.No	Physical properties of material	S.B.E	RHA
1	Specific Gravity	2.00	2.2
2	Fineness	9%	7%
3	Colour	Brown	Black

E. Hydrochloric Acid (HCl)

Table V Physical properties of HCl

1	Empirical formula	HCL
2	Molecular weight	36.47
3	Melting point	-18 0 C
4	Boiling point	103 0 C
5	Specific heat	3.47 kJ/kg
6	Density	1.048kg/L

F. Water

Table VI Physical properties of Water

S. No	Property	Value
1	PH	6.90
2	Taste	Agreeable
3	Appearance	Clear

G. Super Plasticizer (SP)

Conplast SP430 is used for this investigation. It is used for obtaining high degree workability and its retention are required, where delays in transportation or placing are likely

or when high ambient temperatures cause rapid slump loss. It facilitates production of high quality concrete. Conplast SP430 obeys with IS:9103:1999 and BS:5075 Part 3 and ASTM-C-494 variety 'F' on a high range water reducing admixture and Variety G on high dosage. Conplast SP430 was used to give 25% of water reductions without loss of workability or to produce high quality of concrete with reduced permeability.

V. OBJECTIVE OF THE PROJECT

The objectives of this experimental project study are

- To study the effect of concrete, when Cement is partially replaced with Rice husk ash and Spent bleaching earth.
- To study the workability, strength and durability properties of concrete of grades M30.

This work presents the laboratory investigations carried out studies on fresh and hardened properties of concrete.

VI. EXPERIMENTAL INVESTIGATION

In the present study, concrete of M30 grade with water-cement ratio of 0.38 is considered. This study examined the Mix design for M30 with partial replacement of cement with rice husk ash and Spent bleach earth.(i.e., Control mix, 2%RHA, 4%RHA, 6%RHA, 8%RHA, 10%RHA,5%SBE, 7.5%SBE, 10%SBE) based on the IS 10262-2009. With the above variables 66 cubes were cast and tested at the age of 7 and 28 days for compressive strength. From the obtained compressive strength results the optimum percentage of replacement of RHA and SBE, cylinders and beams were cast and tested at the age of 7 and 28 days for split tensile strength and flexural strength. A durability test such as placing in HCL acid is conducted.

Table VII Mix proportions of concrete (quantities in kg/m³)

Mix Plan	w/c	% Variation	Binder(kg)		Water (Lt)	CA (kg)	FA(kg)	SP430 (Lt)
			Cement	Variation				
Control Mix	0.38	0	400	0	152	1220.53	696	2.39
RHA 2%	0.38	2	392	8	152	1220.53	696	2.39
RHA 4%	0.38	4	384	16	152	1220.53	696	2.39
RHA 6%	0.38	6	376	24	152	1220.53	696	2.39
RHA 8%	0.38	8	368	32	152	1220.53	696	2.39
RHA 10%	0.38	10	360	40	152	1220.53	696	2.39
SBE 5%	0.38	5	380	20	152	1220.53	696	2.39
SBE 7.5%	0.38	7.5	370	30	152	1220.53	696	2.39
SBE 10%	0.38	10	360	40	152	1220.53	696	2.39
C+R8+S5	0.38	8+5	348	52	152	1220.53	696	2.39

VII. RESULTS AND DISCUSSION

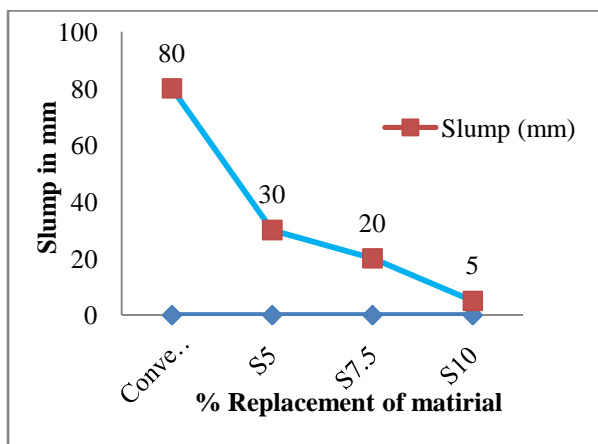
A. Slump cone test

The slump values for different % of spent bleaching earth and Rice husk ash are decreasing due to absorption of water. The slump values are tabulated below. The results are also shown in graphical form.

Observation: It is observed that the slump values are decreasing with increase of % of spent bleaching earth.

Table VIII Slump values for different % of SBE

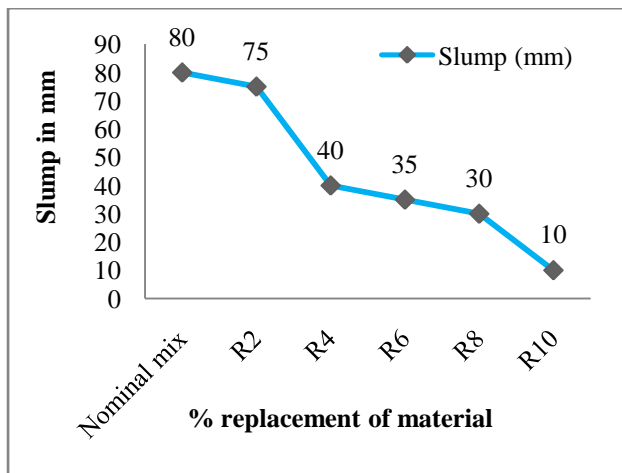
S.No	% of SBE	Slump in mm
1	0%	80
2	5%	30
3	7.5%	20
4	10%	5



Graph 1. Slump Vs % of Spent bleaching earth

Table IX Slump values for different % of R.H.A.

S.No	% of R.H.A.	Slump in mm
1	0%	80
2	2%	75
3	4%	40
4	6%	35
5	8%	30
6	10%	10



Graph 2. Slump Vs % of Rice husk ash

B. Compressive Strength

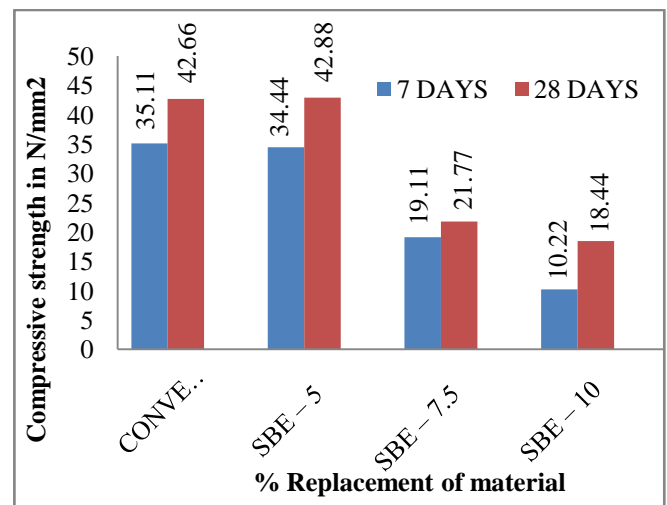
The compressive strength of concrete was done on 150x150x150 mm cubes. Testing of the specimens was done

at 7 days and 28 days, at the rate of three cubes for each mix that particular day. The average value of the 3 specimens is reported as the strength at that particular age.

The compressive strength test was conducted for all the mixes and the results are shown in below

Table X Compressive strength of concrete for SBE replacement

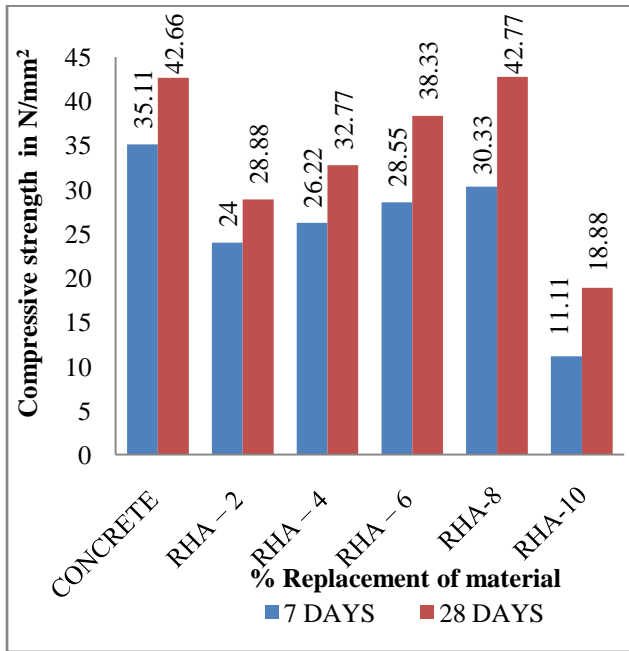
S.no	% of replaced cement in	Compressive strength in N/mm2	7 days	28 days
1	0%	35.11	35.11	42.66
2	5%	34.44	34.44	42.88
3	7.5%	19.11	19.11	21.77
4	10%	10.22	10.22	18.44



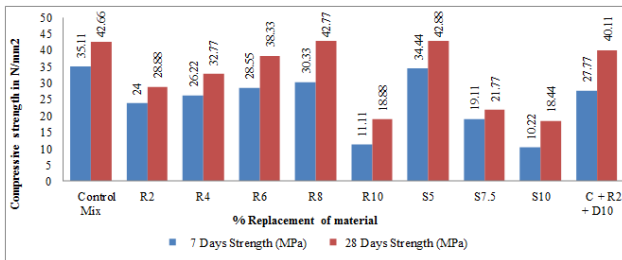
Graph 3. Compressive strength of concrete for different % of S.B.E

Table XI Compressive strength of concrete for different % of RHA

S.no	% of RHA replaced in cement	Compressive strength in N/mm2	7 days	28 days
1	0%	35.11	35.11	42.66
2	2%	24	24	28.88
3	4%	26.22	26.22	32.77
4	6%	28.55	28.55	38.33
5	8%	30.33	30.33	42.77
6	10%	11.11	11.11	18.88



Graph 4. Compressive strength of concrete for different % of R H A

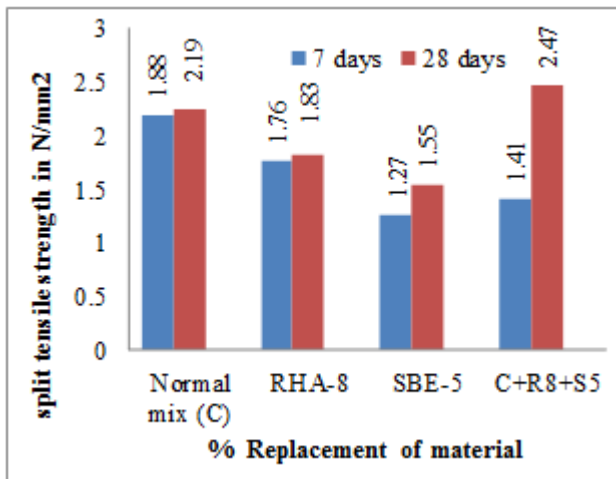


Graph 5. Compressive strength of concrete for different % of R H A & SBE

C. Split Tensile Strength

Table XII Split tensile strength Vs optimum % Replacement

Percentage Replacement	7 days strength in N/mm2	28 days strength in N/mm2
Conventional mix	1.88	2.19
R H A-8	1.76	1.83
S B E-5	1.27	1.55
C+R8+S5	1.41	2.47



Graph 6. Split tensile strength of concrete for S.B.E Vs R H A

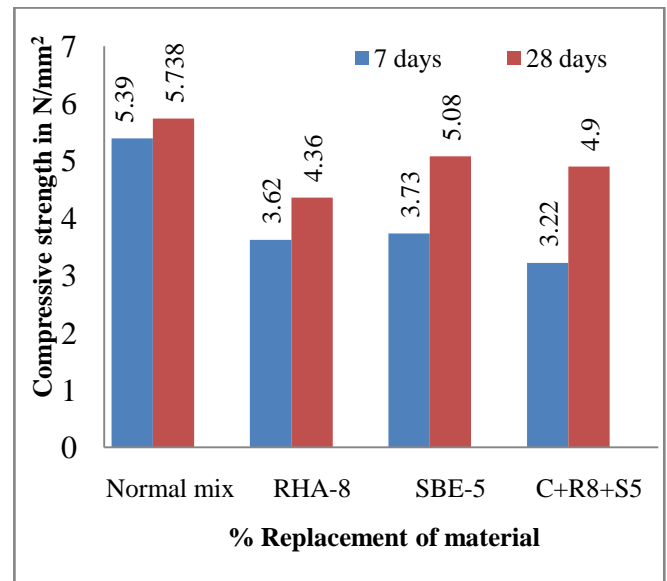
D. Flexural Strength

The flexural strength of the concrete was determined from modulus of rupture test on beam specimens of 700x150x150 mm size.

Here also, a total of 24 specimens were cast out of which three specimens were tested for each mix at 7 days and 28 days.

Table XIII Flexural strength Vs optimum % Replacement

Percentage Replacement	7 days strength in N/mm2	28 days strength in N/mm2
Conventional mix	5.39	5.73
RHA-8	3.62	4.36
SBE-53	3.73	5.03
C+R8+S5	3.22	4.90



Graph 7. Flexural strength of concrete for S.B.E Vs R H A

E. Durability Test

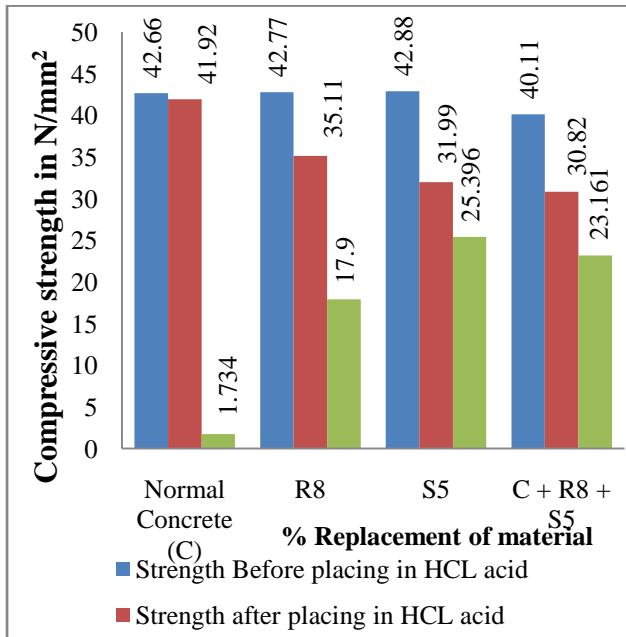
Compressive Strength

Durability test results at different ages on concrete with replacement of spent bleaching earth and Rice husk ash shown in table XIV.

Table XIV Compressive strength loss for control and replaced mix

Percentage of Replacement	Strength Before placing in HCL acid (N/mm2)	Strength after Placing in Acid (N/mm2)	Percentage of loss
Conventional mix	42.66	41.92	1.734
RHA-8	42.77	35.11	17.90
SBE-5	42.88	31.99	25.396
C+R8+S5	40.11	30.82	23.161

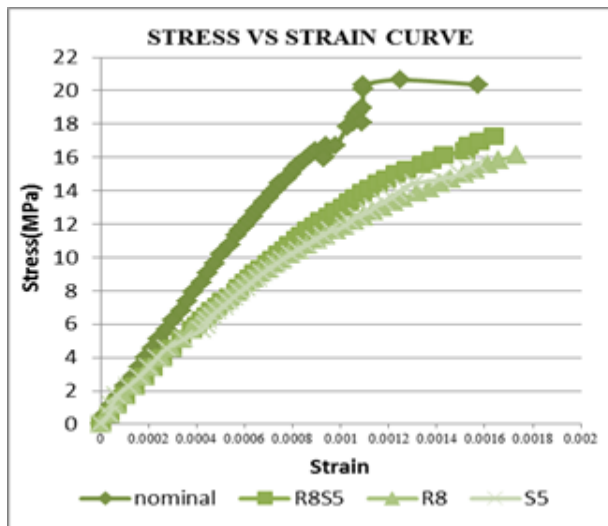




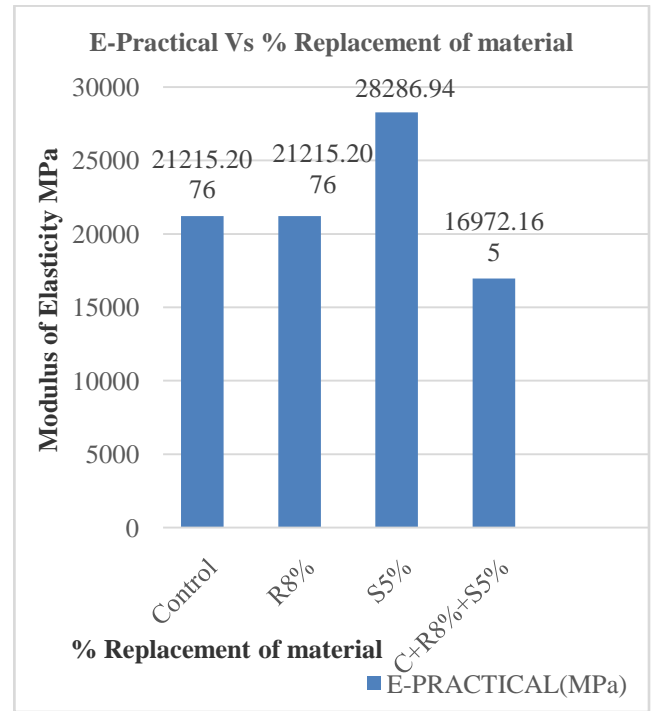
Graph 8. Compressive strength Vs % Replacement of material

Table XV EC values for the % replacement material

% Replacement	E_c Theoretical $5000\sqrt{f_{ck}}$ MPa	E_c Practical MPa
Control Mix	27386	21215.2076
R8	27386	21215.2076
S5	27386	28286.94275
C+R8+S5	27386	16972.165



Graph 9. Stress strain curves for % replacement of mixes



Graph 10. E-Practical Vs % Replacement of material

VIII. CONCLUSION

Based on the study, following conclusions may be drawn.

- The percentage replacement of cement with RHA, SBE reaches the target strength but gives less strength compared to control concrete mix.
- With 0.38w/c and 0.7% of SP430, concrete has low workability, as the slump was true slump.
- The workability of concrete was decreased with increased percentage variation of Rice husk ash and De oiled earth.
- At 8% replacement of RHA maximum compressive strength is observed at 7days i.e 30.33MPa and at 28days 42.77MPa respectively.
- Split tensile strength obtained is 1.76MPa and 1.83MPa at 7 and 28 days respectively.
- Flexural strength obtained is 3.62MPa and 4.36MPa at 7 and 28 days respectively.
- At 5% replacement SBE has maximum compressive strength at 7days 34.44MPa and 28days 42.88MPa when compared with remaining percentages.
- Split tensile strength obtained is 1.27MPa and 1.55MPa at 7 and 28 days respectively.
- Flexural strength obtained is 3.73MPa and 5.08MPa at 7 and 28 days respectively.
- With combined optimum% replacement of RHA and SBE in cement with w/c = 0.38 workability decreased. The compressive strength of 27.77MPa and 40.11MPa were observed at 7 and 28 days respectively.
- Split tensile strength obtained is 1.41MPa and 2.47MPa at 7 and 28 days respectively.
- Flexural strength obtained is 3.22MPa and 4.90MPa at 7 and 28 days respectively.

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- xiii. Compressive strength gaining of SBE was slow at early ages, as the days progressed rate of gaining increased when compared with control mix.
- xiv. The effect of using optimum contents of RHA, SBE as partial replacement of concrete has better resistance to acid than control concrete.
- xv. The weight loss is reduced for the specimen immersed in Hydrochloric acid after 28 days than control specimen due to simultaneous replacement of RHA and SBE.
- xvi. Likewise compressive strength of concrete with SBE after 28 days immersion in Hydrochloric acid is 1.734% lesser than the concrete with 28 days water immersion.
- xvii. It was found that there is a beneficial effect of incorporating combination of RHA and SBE on concrete Hydrochloric acid resistance.

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