LIST OF DOCUMENTS IN ESCSI LIBRARY RELATED TO AVAILABILITY OF RAW MATERIALS FOR MANUFACTURE OF LIGHTWEIGHT AGGREGATE

ESCSI Number:	9600.030	**Author:**	McCarl, Henry N.
Title	The Lightweight Aggregate Industry in New England		
Publication Name:	Research Report to Federal Reserve Bank of Boston		
Issue/Volume:	September 1, 1962	Dated: 1962	Page(s): 1-100 Type of Publication: Book
Publisher:	Federal Reserve Bank of Boston		

The first part of this study includes descriptions of the various lightweight aggregate materials and the properties which make them desirable. It incorporates a brief history and description of the industry as it exists today in the United States, and some comments on structures in which considerable savings have been realized by the use of lightweight aggregates. It also covers, in some detail, the industry in New England, including a review of the plants which have operated, those which will be in operation shortly, and some comments on lightweight aggregates shipped into New England.☐ The second part of the study is a survey of lightweight aggregate raw materials in New England supplemented with data from field investigations and laboratory testing of various samples from all over New England. A breakdown by states of the potentially useful materials is given.☐ Part three of the study is an analysis of the industry and the outlook for its future in New England.

ESCSI Number:	9600.001	**Author:**	Bush, A. L.
Title	Lightweight Aggregates		
Publication Name:	U.S. Mineral Resources U.S. Geological Survey Professional Paper 820		
Issue/Volume:	1971	Dated: 1971	Page(s): 333-355 Type of Publication: Article
Publisher:	U.S. Geological Survey		

The United States is adequately supplied with both structural lightweight aggregates (scoria, volcanic cinder, pumice and pumicite, expanded clays, shales and slates, diatomite, expanded blast-furnace slag, and fly and bottom ash) and ultralightweight aggregates (expanded perlite, expanded pumicite, and exfoliated vermiculite). The aggregates are low unit value, high place value materials, partly because large quantities are available and partly because normal weight (sand and gravel) and synthetic aggregates are stiff competition. However, they have high place value, in as much as transportation costs largely determine whether they are used.☐☐Recoverable reserves of expanded clays, shales and slates are equivalent to about half the cumulative output needed through the year 2000. For the same period, scoria, cinder, pumice, and pumicite reserves are at least twice the estimated demand, and perlite reserves seem to be at least as large, and vermiculite reserves somewhat larger than their respective demands.☐☐Virtually no export or import markets exist for the lightweight aggregates. Along the eastern seaboard, oceanic freight rates allow competition between pumice from western domestic sources and pumice imported mostly from the Mediterranean area, but only a few hundred thousand tons per year are involved. For similar reasons, a few thousand tons of vermiculite are imported annually from the Republic of South Africa. A few thousand tons of domestic perlite are explorted to Canada per year.☐☐The prospects for converting hypothetical and speculative resources of clay, shales, scoria, cinder, pumice, and pumicite to recoverable reserves are excellent. For perlite and vermiculite, the prospects are good.☐

ESCSI Number:	9660.006	**Author:**	Schmutz, F.C. and Harry W. Monahan
Title	Establishing a Lightweight Aggregate Plant, Using Marine Clays in York County, Maine		
Publication Name:	Establishing a Lightweight Aggregate Plant, Using Marine Clays		
Issue/Volume:	November	Dated: 1964	Page(s): 1-75 Type of Publication: Book
Publisher:	U.S. Department of Commerce/Area Development Administration		

Preliminary reconnaissance surveys followed by detailed hand-auger drilling established the presence of workable marine clay reserves in excess of 25 million cubic yards in York County, Maine. This volume is considered more than adequate for the basis of a lightweight aggregate operation in the area. Various deposits in two major areas, Eliot and Arundel, are described in detail.

ESCSI Number:	9106.006	**Author:**	Doyle, Robert G.
Title	Results of New Research Investigation Into the Use of Glacial Marine Clay as a Source of Lightweight Aggregate		
Publication Name:	Research Progress Report		
Issue/Volume:	April 17	Dated:	1962
Page(s):	1-4 + tab, fig.	Type of Publication:	Paper
Publisher:	Maine Geological Survey		

This paper is a follow-up to an earlier investigation of Maine Geological Survey on glacial marine clay. Glacial marine clay is considered as a source raw material for LWA.

ESCSI Number:	9600.086	**Author:**	Cole, W.A. and J.D. Zetterstrom
Title	Investigation of Lightweight Aggregates of North and South Dakota		
Publication Name:	Bureau of Mines Report of Investigations 5065		
Issue/Volume:	July	Dated:	1954
Page(s):	1-43	Type of Publication:	Paper
Publisher:	U.S. Dept. of Interior, Bureau of Mines		

This preliminary investigation of North and South Dakota shales and clays began in late 1952. It was a reconnaissance survey to determine locations of possible suitable raw materials for lightweight-aggregate manufacture. One or more samples from each of a number of deposits were taken and tested. Small-scale laboratory equipment was used in determining the bloating temperature ranges. A further objective of this investigation was to study the feasibilities of the industries in the two states.☐ Samples from several deposits proved to be good bloaters. However, it must be pointed out that the samples were spot samples, and they cannot be considered as being representative of the deposits. Hence, reserves and average quality of the deposits as materials for lightweight-aggregate products remain to be established by drilling and small-scale pilot-plant testing.

ESCSI Number:	9106.014	**Author:**	White W.A.
Title	Lightweight Aggregate form Illinois Shales		
Publication Name:	Illinois State Geological Survey		
Issue/Volume:	Circular 290	Dated:	1960
Page(s):	1-29	Type of Publication:	Paper
Publisher:			

This investigation was made 1) to determine which shales are self-bloating and which require the addition of bloating agents and 2) to study the mechanism of bloating. Samples of shale ranging in age from Ordovician to Pleistocene were collected from brick and lightweight aggregate pits, strip coal mines, outcrops, and drill cores.

The samples were crushed, screened, and analyzed chemically and mineralogically. The coarse material was put in a crucible and heated in a furnace at 2200 ºF for one hour, and the apparent specific gravity was determined.

The optimum organic carbon content for self-bloating shales was found to be between 0.3 and 1.0 percent. Too much carbon kept the shale from bloating and too little prevented the desired bulk density from developing. Most of the nonbloating shales bloated after the addition of 1 percent of fine coal.

Too much kaolinite and/or quartz make the material too refractory for economic production of aggregate. Too much dolomite and/or calcite cause too narrow a firing range.

Self-bloating shales probably could be made into lightweight aggregate in both rotary and grate-type kilns. Shales that need bloating agents added could be processed in a grate-type kiln in which the fuel is mixed with the shale.

ESCSI Number:	9106.018	**Author:**	Plummer N.; Hladik W.B.
Title	The Manufacture of Lightweight Concrete Aggregate from Kansas Clays and Shales		
Publication Name:	University of Kansas Publications, State Geological Survey of kansas		
Issue/Volume:		Dated: 1951	Page(s): 1-100
Publisher:			

Type of Publication: Book

Lightweight aggregates have been in increasing demand during the past few years for use in all types of concrete, but particularly in vibrated concrete blocks. This increasing demand has been due to several advantages the lightweight materials have over the conventional heavy aggregates. These advantages include better sound and heat insulation and savings in both cement and structural steel due to the lessened dead weight. Supplies of bloated shale aggregates have been entirely inadequate to meet the demands not only in Kansas but over most of the United States. The need for the lighter weight materials is so acute that an enormous tonnage of pumice has been shipped from New Mexico and elsewhere to as far from the source of supply as Chicago.

Tests on 227 samples taken from 47 counties in Kansas indicate that raw material suitable for the production of lightweight aggregates are available throughout most of the State. The most abundant supply of raw materials has been found in the eastern one-third of Kansas, but in the western two-thirds the supply of suitable raw materials is far in excess of any possible demand.

Tests were conducted in a high-temperature electric furnace and a batch-type rotary kiln. Results were checked in a 30-foot pilot-plant continuous rotary kiln. Materials tested include shales of Pennsylvanian, Permian, and Cretaceous age, and clays of Cretaceous, Tertiary, and Pleistocene age.

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ESCSI Number:	9184.003	**Author:**	Brown, Calvin S.
Title	The Lignite of Mississippi		
Publication Name:	Mississippi State Geological Survey, Bulletin No. 3		
Issue/Volume:	July 20	Dated: 1907	Page(s): 1-71
Publisher:	Mississippi State Geological Survey		

Type of Publication: Book

This book is a geological survey of Mississippi lignites. An added feature is that it describes and maps clays as well as the lignite. A full geologic map of Mississippi (1907) is attached to the back of the report. The clay occurs with the lignite and the two could be used together in producing expanded clay aggregate.

RELATED DOCUMENT REGARDING THE AVAILABILITY OF RAW MATERIALS FOR MANUFACTURE OF LIGHTWEIGHT AGGREGATE IN THE UK

ESCSI Number:	9803.004	**Author:**	Evans, R.H. and T.R. Hardwick				
Title	Lightweight Concrete With Sintered Clay Aggregate						
Publication Name:	The Reinforced Concrete Review						
Issue/Volume:	June, Vol. V, No. 6	Dated:	1960	Page(s):	369-400	Type of Publication:	Paper
Publisher:	Reinforced Concrete Association in London						

The use of manufactured lightweight fine and coarse aggregates in this country for general concrete construction is increasing rapidly and it is becoming clear that lightweight aggregates will eventually replace much gravel concrete in structural engineering construction. In USA manufactured lightweight aggregates were used for bridge decks over 25 years ago and today skyscrapers of reinforced lightweight concrete are commonplace and bridges of prestressed lightweight concrete are being built.☐ The advantages of manufactured lightweight concrete construction may be summarized briefly as follows:☐ (1) Less dead-weight of structural member with a consequent reduction in the size of slabs, beams, columns and foundations;☐ (2) Improved heat insulation;☐ (3) Greater resistance to fire;☐ (4) Less trouble with mix design or grading, due to careful control of aggregate production;☐ (5) Easier placing of concrete, with lighter shuttering;☐ (6) Greater resilience of structural member due to lower value of modulus of elasticity.☐ These advantages are of such a nature that it is surprising so little attention has been given to lightweight aggregates and their use. At the same time a study by the Geological Survey of the resources of Great Britain shows that good gravel aggregates are beginning to be in short supply. In London and many provincial cities increasing haulage distances of gravel aggregates are envisaged and energetic efforts are being made to make better and greater use of power station fly ash and of foamed slag as lightweight aggregates in the manufacture of both non-structural and structural precast and in-situ concrete products. On the other hand, and in contrast, the raw materials required for the manufacture of lightweight aggregates are usually close to the furnace plant.