The impact of flue gas desulphurisation on lim and limestone marketing

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Abstract

Sulphur dioxide removal, or flue gas desulphurisation (FGD), has become a major concern to coal-fire electric generating stations and industrial boiler operators in the United States. Since 1971 there has bee an increasing emphasis on air quality, with the latest and most stringent regulations having now bee promulgated under the US Environmental Protection Agency's 1977 Clean Air Act Amendments. As result of these air quality requirements, a variety of FGD systems are now being developed. Almost all these systems utilise lime or limestone as the reagent material for sulphur dioxide removal, and thus flue g desulphurisation would appear to be a promising new market for the lime and/or the limestone industry.

Because of the volume of coal burned by the electric power generating industry and the degree of a quality control which is being required, FGD has already become a major new market for lime and lim stone. As the lime and limestone industry looks ahead to future expansion and facilities development, th demands of the FGD market deserve critical examination. Thus far, product quality and costs have bee key items; with changing technology, however, volume requirements and specifications have become som what of a moving target and are still changing.

This paper briefly examines the type of FGD systems that have been successfully employed to date ar those systems currently being brought into commercial utilisation. The potential application of each these systems and their reagent requirements are then discussed both in terms of quality specifications ar overall anticipated volume requirements. Reagent materials considered include lime, limestone, dolomit and magnesium-enhanced lime and limestone.

Questions relating to the future demand for lime and limestone for use in sulphur dioxide removal sy tems are discussed in light of the impact this new market will have on existing sources and producer Where will the lime/limestone be needed and where will it come from? Is there adequate lime productic capacity available to meet the potential 1980-2000 environmental demand, or is this market only a mirage Are there adequate reserves available to meet the requisite quality requirements? Can quality be sacrifice to achieve transportation cost savings? Will the lime/limestone producer have to change his marketir approach in order to achieve a share of the market?

Discussion

Federal Clean Air Requirements

In 1971 the United States Environmental Protection Agency (EPA) implemented the Clean Air Act with the promulgation of a set of air pollution control regulations. These requirements became known as the New Source Performance Standards and had the net effect of requiring all coal-fired electric generating stations starting construction after 1971 but prior to September 1978 to limit their SO_2 emissions to not more than 1.2 lb/million BTU. In essence this left the utilities with the choice of either burning low sulphur "compliance coal", or using medium to high sulphur coals with scrubbers.

As of September 1979, 56 coal-fired power generating units were equipped with operating flue-gas desulphurisation (FGD) systems.[1] These units represent a total controlled capacity of 21,104 megawatts (MW), or 9.2 percent of the US coal-fired generating capacity. However, as the impa of the 1971 Clean Air Act began to be felt and as FG technology expanded, federal officials recognised th certain revisions to the Clean Air Act were necessar As a result, in August 1977 amendments to the Clean A Act were passed by the US Congress, and in May 1979 t EPA issued a revised set of New Source Performan Standards.

The revised standards provide the utilities with a broad range of options in the selection of the coal they w use and the manner in which sulphur removal will accomplished. However, all coals will be subject to sulph removal requirements, no matter what their original sulph levels may be, as there is no specific floor for sulph dioxide emissions. The regulations classify coals into thr categories, each with a different level of required SC reduction. Thus, the concept of "compliance coal" h been effectively eliminated.

Impact on Coal Utilisation

In addressing the market potential for lime and limestone reagent materials for SO_2 removal, it is necessary to have some understanding of what coals are likely to be burned and where. Since there is considerable variation in coal quality from one region of the USA to another the specific SO_2 removal options most likely to be considered by a utility will vary with geographic location. Thus the more probable options which will be considered are as follows:[2] (a) Western utilities will utilise western coals originating in Colorado, Montana, Utah, and Wyoming. Most of these coals can be used with the 70% dry scrubbing option, which is discussed later, although several of the plants are expected to opt for wet scrubbing. (b) In the southwest the utilities have the option of using either western bituminous or sub-bituminous coals, or lignites. Sulphur content in these lower grade coals tends to vary, and this combined with the lower heating values means that the probable options available would be dry scrubbing, dry scrubbing combined with derating boiler capacity as sulphur levels increased, or wet scrubbing. If and when fluidised-bed combustion becomes a viable alternative for plus 250 megawatt (MW) units, this is the area in which it may first be employed. (c) Southern utilities have traditionally used Appalachian coals which have low to high sulphur values depending upon the particular seam utilised. However, southwestern lignites and western low sulphur coal have been selected by some utilities in this area. (d) Mid-western utilities also have a wide range of fuel alternatives. Low sulphur western and east Kentucky coal is available as well as the medium to high sulphur coals of western Kentucky, Illinois, Indiana, and Ohio. Sulphur removal in this region will most likely be achieved via wet scrubbing or a combination of wet scrubbing and coal washing. (e) In the eastern states the transportation costs associated with the use of low sulphur coals tend to eliminate them from consideration for most utilities. Therefore, medium sulphur Pennsylvania coal is expected to be the primary source of fuel for any new plants. Thus, wet scrubbing is expected to be the primary mode of sulphur removal, although a greater degree of technical innovation may be seen in the eastern states. Coal-oil mixtures, blended coals, and solvent refined coals (SRC) may be considered.

Scrubber Technology

Of the existing generating units with commercial FGD systems over ninety percent employ wet calcium-based lime/limestone processes. These systems include lime, "Thiosorbic"® lime, carbide lime, lime/alkaline fly as limestone, and limestone/alkaline fly ash. The remainir include magnesium oxide, sodium carbonate, and t Wellman Lord processes. Of these, the limestone ar "Thiosorbic" lime systems are employed on the mo units generating the greatest number of megawatts.

While there has been much discussion about the re ability and efficiency of wet scrubbing, it has been demo strated that wet scrubbing is a viable technology and th 90 percent plus efficiency in sulphur removal can achieved.[3] With these kinds of results and the consiste improvements in system reliability and efficiency beir achieved through increased operator experience, w scrubbing is being selected by an increasing number utilities as the preferred method of sulphur remova Further, despite initial differences in reagent costs, lime v limestone, it has been demonstrated that lime and "Thi sorbic" lime systems continue to be technically and ec nomically competitive alternatives available to the utilit industry.[4]

But what about alternative technology? Over the la decade a tremendous effort has been put forth to fin alternative methods of sulphur removal. Of these, dr scrubbing, which uses lime or sodium as a scrubbing reagen has already found commercial acceptance in the norther plains states where it has been selected by Basin Electri Power Cooperative.[5] Initial results indicate that this proce will be particularly adaptable to those units using lo sulphur western coal and requiring only 70 to 85 percer removal. Further, due to the generally better availabilit lime is emerging as the preferred reagent material. Howeve at this point in the development of the dry scrubber, it doe not appear that it will be suitable for medium and hig sulphur coals due to the higher removal efficiencies require for these coals. Also, the waste products are by nature dr and can be quite high in alkalinity, thus raising questior concerning the disposal of these materials. This is partic ularly important in areas of high rainfall where the erosive ness and solubility of these wastes could contribute to the introduction into surface and/or ground water.

A second technology which has received a great deal o publicity is that of fluidised-bed combustion (FBC). Thi process utilises dry limestone and has been extensivel studied by Westinghouse and others.[6,7] One of the primar advantages of fluidised-bed combustion is that it can utilis a broader quality range of limestones than most of th

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Table 1—Quality characteristics of coal and estimated annual lime/limestone consumption per megawatt

Source of Coal	*Btu/Lb.*	*%S*	*Required SO_2 Removal*	*Lime (mt) Yr . MW*	*Limestone (mt) Yr . MW*
East Kentucky	11,796	1.26	71.9	38	78
West Kentucky, West Virginia	10,996	3.59	90.0	147	299
Illinois	10,775	2.92	88.9	121	245
Texas	6,601	0.66	70.0	35	72
Colorado	10,925	0.49	70.0	15	32
New Mexico, Arizona	9,996	0.54	70.0	19	38
Wyoming	9,037	0.50	70.0	19	39
Pennsylvania	12,200	2.22	83.5	76	154

other sulphur removal systems.[8] Unfortunately, as of this date the FBC has been used only on small industrial boilers and in pilot plants. As yet the system has not been scaled up, and due to the capital cost and complexity of the material handling and feed systems may never be employed on larger generating units with 250 MW plus capacities.

Other sulphur removal processes include solvent-refined coal cleaning, chemical coal cleaning, and coal gasification. In addition coal-oil mixtures, blended coals, and coal washing via standard coal preparation technology are being considered in an attempt to reduce the sulphur levels prior to firing. Nevertheless, wet lime/limestone scrubbing is expected to predominate in reducing SO_2 emission levels over the next ten to fifteen years.

Reagent Requirements

If wet lime/limestone scrubbing is expected to be used by new generating units coming on line between 1980 and 1995, and if lime will be employed by the dry scrubbers, what size market does this actually represent? *Table 1* shows the annual estimated lime or limestone consumption per megawatt which would be anticipated with a variety of different coals. These estimates are based upon a 65% load factor, 10,000 BTU/kilowatt hour, stoichiometry of 1.05 for lime and 1.2 for limestone, and a minimum 95% CaO or $CaCO_3$. Taking the information in Table 1 a step further, assume a 600 MW generating station using eastern Kentucky coal. From the table it is noted that the average eastern Kentucky steam coal would require 38 metric tons (42 short tons) of lime or 78 metric tons (86 st) of limestone per megawatt per year to achieve the required sulphur removal levels. Therefore, a 600 MW unit would require 22,800 metric tons (25,200 st) of lime or 46,800 metric tons (51,600 st) of limestone per year.

The size of the actual potential market is, however, difficult to define specifically. For instance, fifteen selected units in the Ohio River Valley, representing a total generating capacity of 8542 megawatts, are planned to be brought on line between 1982 and 1990. These fifteen units will burn an average 3.4 percent sulphur coal requiring 90 percent plus removal efficiency. Thus, these selected units alone represent a potential annual market of 1,156,062 tonnes (1,274,600 st) of lime or 2,427,730 tonnes (2,676,660 st) of limestone. On the other hand, these same 15 units, located in the West and burning Colorado-Wyoming-Utah type coals, would represent an annual market of only 128,130 tonnes (145,214 st) of lime or 273,344 tonnes (298,970 st) of limestone. While this is an extreme example it does demonstrate the impact on lime/limestone market predictions which the various options available to a utility can have.

Earlier it was noted that 56 coal-fired generating units were equipped with operating FGD systems. In addition to these units there are 42 more which are under construction, 19 for which contracts have been awarded, 18 planned and are evaluating system alternatives, and 26 in the early phases of study.[9] This is a total of 161 units representing an overall capacity of 76,335 MW, or over three times the operational capacity of existing generating units with FGD systems. Of these 161 units 61 fall into the category of being under construction or having had a contract awarded, and thus represent a relatively near-term pending market. *Table 2* summarises the anticipated coal quality which will be used in these new units, and attempts to estimate the lime/limestone market which these units represent. While the lime and limestone requirements are estimates only they are believed to be reasonable based upon reagent usag in operational FGD systems.

The estimated figures included in Table 2 make up onl part of the market forecast. Long-range estimates of th impact of FGD system requirements on lime and limeston demand are complicated by the fact that 44 of the 16 units mentioned earlier have yet to make an FGD syster selection. Assuming that these 44 units, representing a additional 26,113 MW capacity, utilise approximately th same relative lime and limestone quantities, the tota projected new requirements to 1990 would be 1,726,04 metric tons (1,902,962 st) of lime/year and 2,952,19 metric tons (3,254,797 st) limestone/year.

It must be noted that in preparing an estimate of futur FGD system demand there are a number of recent politica and economical events which may significantly impac utility expansion plans. For one, since the Three Mil Island incident in 1979 there has been a noticeable slo down in planning for nuclear power generating facilitie It is possible that as a result of escalating costs, majo permitting questions, etc., that utilities which had nuclea power plants on the drawing boards could switch to coa fired units. Additionally, with the increase cost of petro leum products and transportation combined with th revised New Source Performance Standards there may b less incentive for the utilities to opt for low sulphur wester coals. Again there may be revisions in plans with th consequence being that higher sulphur coals could be i greater demand. Two additional considerations which ar not included in this market projection are the impacts c retrofitting existing boilers with FGD equipment, and coa conversion. As yet it is not clear how many existing unit may be required to retrofit, and if so required will th utilities elect to deactivate these plants? Also, there i considerable impetus at the moment to require oil and ga fired units to convert to coal, particularly in the northeas There is a distinct possibility that an incentive to conve sion may be to not require scrubbing, or if required t reduce the attainment levels. Finally, the anti-coal attitude of the Pacific coast states are gradually changing, an coal-fired plants are now anticipated for California, Oregon and Washington. The net result of all of this is that th demand for lime and limestone reagent materials for FG systems could increase beyond the figures presented herein

One additional area which has not been discussed is tha of the smaller industrial boilers. Sulphur dioxide remova requirements are already being implemented for coal-fire industrial boilers in several parts of the country. Howeve while many of these boilers will have scrubbers it is antic pated that this is the market where fluidised-bed combustio will have its greatest impact. Since these boilers can utili a wide range of limestones and generally require 25,00 tons or less of stone per year, it is expected that the requirements will normally be supplied by the local quarry man or supplier with the most reasonable delivered price.

Market Location

Assuming that the projected expansions take place the ne question is where will these plants be located. Two of th major items in locating a power plant are a source o cooling water and transportation. *Figure 1* shows th location of the major new power plants in the USA. Fro this it can be seen that the majority of the new units will b in the eastern half of the nation and that many of them a on or near navigable water.

In looking at the locations of these plants, relative t

Table 2—Summary of new FGD systems, anticipated coal quality, and potential lime/limestone requirements

FGD Process	Capacity (MW)	Coal Quality		Estimated Reagent Requirements/Year*	
		Heating Value (BTU)	Sulphur	Lime (mt)	Limestone (mt)
Dual Alkali	None				
Lime	1,854	9500–12500	0.5–1.0	67,500	
	1,120	10500–11500	2.0–3.0	117,600	
	3,690	11000–12200	3.0–4.7	542,430	
Limestone	1,166	6500– 7500	1.2–1.8		169,070
	5,439	7500–10000	0.3–0.9		212,121
	1,818	10500–12000	1.2–1.8		141,804
	2,413	10250–12500	2.0–3.7		395,732
	2,338	9500–11000	3.0–5.5		572,810
Lime/Alkaline Fly Ash	3,097	6250– 8500	0.6–0.8	54,198	
Limestone/Alkaline Fly Ash	None				
Lime/Spray Drying	1,048	6000– 7500	0.4–0.7	36,680	
Others	2,682			53,640	
Totals	26,665			872,048 metric tons	1,491,537 metric tons

**Estimated reagent requirements are based upon weighted average coal quality and SO_2 removal requirements.*

supplying their potential reagent materials, several points clearly emerge. One of these being the necessity to take advantage of cheap transportation. A coal-fired generating plant is set up to handle large bulk shipments of coal, usually by either rail or barge. Current studies show that coal can be moved via waterway transportation at the rate of 37 metric ton-kilometers per litre (250 st-miles per gallon) compared to 29.6 metric ton-kilometers per litre (200 st-miles per gallon) for rail and 8.7 metric ton-kilometers per litre (58 st-miles per gallon).[10] This cost incentive for barge movement leads to projections that coal shipments on the inland waterways will double by the year 2000. These same transportation cost savings are available to the lime/limestone supplier as well.

In view of the volume of lime and limestone which will be used in FGD systems the lime/limestone producer should examine the transportation alternatives available to him. Many producers are already aware of the commercial advantages and importance of cheap transportation, as evidenced by the number of quarries and lime plants already located on the Ohio and Mississippi Rivers. Those producers who are already utilising rail and/or barge transportation in the marketing of their products are probably in the best position to take advantage of the FGD market. However, with the incentive of the additional tonnage potential other operators may be able to justify rail-sidings into their plant or partial relocation of their quarry operations to better facilitate barge or rail load-out.

A second item noted from Figure 1 is the degree of scatter seen in the location of new generating stations in the Rocky Mountain and far-western states. Many of these plants are mine-mouth, or in other words located on coal deposits. Further, since these are basically low sulphur coals, dry lime scrubbing and lime/alkaline fly ash are expected to play a major role in FGD removal here. This in turn would indicate that the per unit annual lime consumption will be modest. This fact combined with the distances involved means that the lime supplier will have to take advantage of any transportation cost savings he can. Also, he will have to coordinate his total marketing effort as it is unlikely that he will be able to rely on this market alone to sustain his operations.

The remainder of the plants shown in Figure 1 are somewhat more randomly scattered and will very likely be supplied on a somewhat more localised basis. This same is also true of the smaller industrial boilers fitted with FGD systems. Nevertheless, as with any of these potential lime/limestone customers the key to marketing success will be found in the delivered cost/ton, reliability, and the ability to meet the requisite quality specification.

FGD lime/limestone specifications

Lime specifications for wet scrubbing are concerned with chemical quality, reactivity, and insoluble residues, much the same as most other lime users. The basic requirements under this specification are generally total oxides 90%

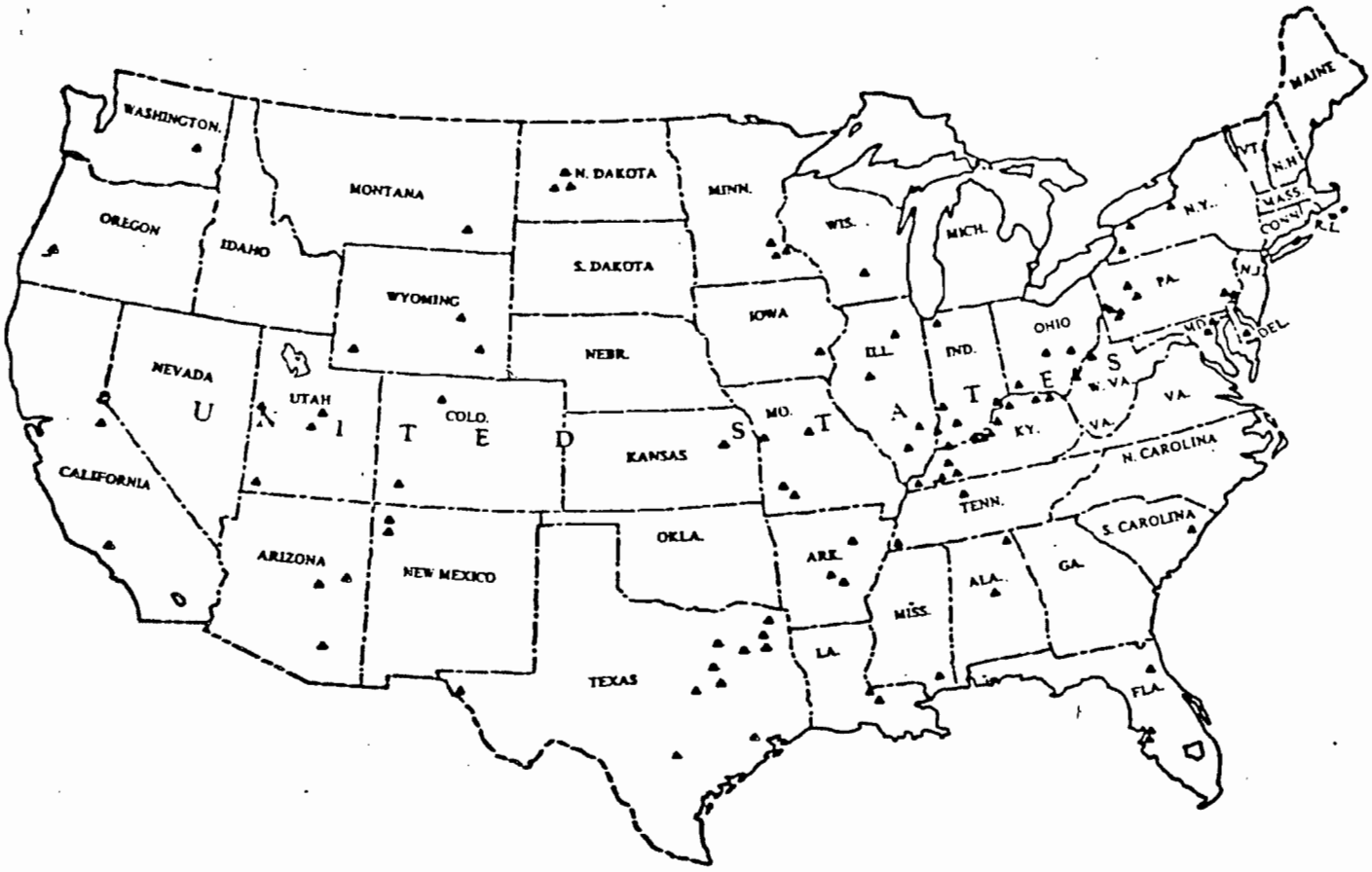

Figure 1. Location of Power Plants With FGD Systems

minimum, silicon dioxide 4% maximum, loss on ignition 3.5% maximum, and insoluble residue 5% maximum. Size specifications will vary, but in general require 5 cm (2inch) x 0 material. Because of the high efficiencies which have been achieved with "Thiosorbic" lime in wet lime scrubbing several lime specifications have included provisions for a minimum 5.0 to 5.5% MgO as a preferred alternative to a straight high calcium lime.

Limestone material specifications have generally included both a chemical and physical specification. The chemical requirements have been 85 to 95% $CaCO_3$, 0 to 5% $MgCO_3$, and not more than 5% inerts. This specification is changing somewhat and several studies currently in progress are investigating the advantages of using magnesium limestones.[11] The second part of the limestone specification relates to stone gradation, and generally requires 100% of the stone to be 1.9 cm (¾ inch) x 0. In some cases the requirement is further modified and requires 90% to be 0.6 cm (¼ inch) x 0. No other physical specification other than an occasional reference to hardness has been included in the limestone specifications. However, the utility has to fine-grind the limestone before feeding it into the scrubber. Work done by Borgwardt and Campbell indicates that ideally the stone should be ground to a minimum of 84% passing the 325 mesh.[12] This may be an area where the limestone supplier can provide additional service to the utility, either by operating the grinding equipment at the generating station, or pre-grinding at the producer's facility.

The major item in either of these specifications is quality control. This is nothing new to the lime industry, which has traditionally monitored its product quality through its own plant laboratories. On the other hand, it may be quite new to many limestone suppliers. Frequently formations are quarried which show wide ranges in quality through the vertical section. Therefore, if these same quarries are to provide stone for FGD purposes, operational procedures may have to be modified to permit selective quarrying or mining and some degree of quality control will have to be implemented.

Material sources

The United States is richly endowed with carbonate rocks, with nearly 725 million metric tons (800 million st) of limestone and dolomite being quarried or mined annually. Limestone quarries/mines are present in 46 of the 50 states, with only Delaware, Louisiana, New Hampshire, and North Dakota not reporting any commercial limestone or carbonate rock production.[13] Obviously, not all of this quarried stone is high-calcium and not all of it could be utilised in FGD systems.

In terms of the potential limestone market for sulphur dioxide removal, it is quite apparent that this does not represent a major impact relative to the total quantity of stone quarried in the United States. It does, however, present a significant opportunity for those producers who have the quality reserves necessary to supply this market, and who are situated so as to realise transportation cost savings. Thus in some regions, such as northeastern Texas the limestone producers within a relatively localised area may find a substantial new market available to them whilst quarries in Georgia and North Carolina may be little affected by FGD.

One area where the limestone quarryman may be able to enhance his ability to supply stone to the utilities is waste

disposal. The coal-fired generating station fitted with an FGD system will produce voluminous quantities of fly ash and scrubber sludges. Depending upon the location and environmental constraints, the quarry may be able to reduce its overall transportation costs by backhauling fly ash and stabilised scrubber sludges for disposal in abandoned portions of the quarry. This would be done on a fixed price per ton disposal fee and could represent an additional source of revenue to the quarry.

The lime industry is in a somewhat different position relative to FGD than is limestone. Total lime production in the United States hovers around 18 million metric tons (20 million short tons) per year of which almost seventy-five percent is sold on the open market. Thus the potential new business represented by sulphur dioxide removal could equal ten percent or more of current production. Unfortunately this potential is very much up in the air as to whether it really exists or not. Scrubber technology is changing and there are many unanswered questions still remaining which will ultimately influence the utilities selection of equipment. Recently a great deal of emphasis has been placed on the cost differential between lime and limestone. However, the lime industry can overcome at least part of this differential by thoroughly understanding the total cost of scrubbing. In other words, a cost analysis approach to marketing, including capital, financing, operating, and disposal cost considerations, must be taken if the lime producer is to be successful. Additionally, the supplier may want to consider providing technical support services to his customers as a further incentive.

Summary of marketing considerations

From the foregoing discussion it is clear that there are a number of factors at work which will influence the degree to which FGD reagent supply does in fact materialise as a major new market. The lime/limestone producer can enhance his ability to realise the potential of at least part of this market if he includes certain basic elements into his marketing strategy.

1. First the producer must have a basic understanding of his potential customers' needs and to have some understanding of scrubbing. In order to assess the size of the market available to his operations he must know the anticipated timing for the new plant or retrofitted system, the type of coal which will be used, and the scrubbing process to be employed. The element of utility timing may be critical since rarely has the published plant start-up date been the same as the actual start-up date. Public hearings, permit delays, reduced consumer demand, etc., can lead to a plant actually coming on-line two years or more behind original schedules. Therefore, the reagent supplier will have to consider the impact these delays could have on his own expansion plans, capital commitments, product mix, etc. Also, the coal quality and FGD process must be known for each unit in order to accurately forecast material volumes.

2. Transportation is a major element in the delivered cost of both lime and limestone. If the quarryman is not already familiar with transportation alternatives and the impact on pricing this could have on any given customer, he should bring himself up to date. This does not mean a top-of-the-head estimate, but to acquire quotations for the actual truck, rail, or barge move anticipated. The advisability of installing a rail siding, additional car storage, different loading equipment, storage silos, or whatever equipment might be germane to his operations should be investigated. He may also want to investigate the receiving facilities of the utility, and may want to recommend the inclusion of additional storage capacity at the plant.

3. The operation of a utility is an all-year function, and unlike the quarry the power plant cannot shut down for bad weather. Thus, during the assessment of transportation alternatives and facilities the quarryman will have to investigate the measures he may have to take in order to assure the FGD system of a reliable supply of reagent materials. Again this may include additional storage capacity at either the quarry/lime plant or the utility, or at both points.

4. Quality control will be a necessary element of production in supplying the utilities' lime and limestone needs. As noted earlier this is something with which the lime industry is familiar. The limestone producer will, however, have to be able to supply calcium and inert values as a minimum, along with material gradations. Additionally, if the quarry does not already have a detailed geologic report on its deposit, including chemical analysis, it should proceed to obtain one. Only with a thorough understanding of quality variations in their reserves can the quarry plan its operations, particularly if selective quarrying is necessary.

5. Since the supply of scrubber reagent materials can require a substantial capital outlay by the producer in order to supply this lime/limestone, the producer may want to enter into a long-term contract for supply with the utility. Coal contracts with the utilities are commonly written for five year periods, and it is reasonable to expect that similar commitments could be obtained for lime/limestone. This type of arrangement may be new to the limestone operation, but it could be most helpful to him in planning both his quarry/mine operations and overall market objectives. Also it would provide a basis for planning any capital expenditures which may have to be made. The inclusion within the contract of an anticipated monthly tonnage schedule might also help to avoid some of the difficulties which are often associated with meeting wide swings in volume demands. These swings will occur and result from changing consumer demand due to heating, air conditioning, etc.

6. Backhauling and disposal of waste products should not be overlooked as a possible adjunct to FGD lime limestone arrangements. This could be a profitable business, and transportation costs on the stone could possibly be adjusted to provide more competitive pricing of delivered stone products. If this is attempted the quarry operator must be sure he is familiar with all the applicable environmental laws and that his disposal fees are adequate to cover all of the costs of compliance with the laws. It makes little sense to make a profit on stone and then lose it all on a disposal operation.

7. There are a variety of technical support services which the lime/limestone operator may want to consider providing to his customers. These services could range from material handling and grinding at the utility to more sophisticated operations such as performing compliance testing. Again, however, these services should be looked upon as a part of the business and their cost covered through product pricing or an established fee

schedule. The availability of these services may help secure the business and could enhance the operator's own knowledge of the FGD business. This in turn could have positive consequences as additional FGD systems come on-line.

8. The last item relates to the first. The producer should learn the language of sulphur dioxide removal. He should be familiar with FGD systems and the total cost per ton of sulphur removed, including all of the various cost elements of scrubbing and scrubber waste disposal. Only when he has a firm grip on these costs can he prepare a detailed cost comparison between his product and that of his competitors. To this end he may want to have his product tested for suitability in a scrubber system. The results of such testing could help him in the marketing of his product, or could possibly even indicate this is the wrong application for his material.

Conclusions

Flue-gas desulphurisation does represent a very real potential market. The size of the market, however, and the relative demand for lime and limestone still remain somewhat of a question. Early projections which forecast a market for 20 to 40 million tons of limestone per year appear now to have been overly optimistic. The market for limestone is expected to reach 3.0 to 3.5 million metric tons per year by the year 1990. This should prove a very nice addition to the tonnage stone produced at those operations situated such that they can take advantage of this new potential. To the limestone producer it means he may have to make some adjustments to his marketing approach and possibly within his quarry/mine operations. These changes should not be difficult to accomplish and could have a very positive impact on his total sales effort.

The projected lime market of 1.7 to 2.0 metric tons is somewhat more elusive than the limestone predictions. Technological developments over the next five years certainly will bear strongly upon the degree to which this market is realised. Several expansions and/or new lime plants have been announced for the early 1980s, but if the market approaches current predictions, additional lime production capacity will still have to be brought on line. Dry lime scrubbing is expected to be a major factor in the western states and should represent a worthwhile potential in this area. Wet scrubbing could predominate in the northeast because of the reduced volume of waste products and the relative availability of lime vs. limestone. The remainder of the market is very much in question, but with an aggressive and knowledgeable marketing effort the lime producers should be able to secure a reasonable share of the FGD business.

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