# construction equipment: environmental tools for progress or destruction

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How man's activities affect his environment is probably the major public issue of the seventies. There are many definitions to the terms environment and ecology. In this paper we will use a fundamental yet inclusive definition, which is that ecology is the study of the interrelation between the various life systems of the earth to the end that man's activities will not upset the balance of nature and eventually destroy his own environment and perhaps himself.

Ecological concerns are expressed in many ways: elimination of pollution, preservation of natural beauty, slowdown of population growth, and elimination of possible hazards to life such as nuclear radiation, unsafe vehicles, and unsafe work places.

Environmentalists can point to a string of successes in stopping—at least temporarily—the construction of proposed major highways, electric power generating plants, airports, and countless small-scale construction projects on municipal and county levels. The environmentalists are now turning their attention to the contractor for his supposedly inattentive attitude toward pollution and particularly his housekeeping habits on jobs in urban areas.

Construction equipment manufacturers who provide the industry with its tools are also being given their share of attention. A host of new regulations and standards are being applied to construction machines through regulatory actions by all levels of government. Those new rules for equipment cover the full spectrum of environmental concerns—water and air pollution; noise abatement; and safety and health of the construction workers and the public who are on or near construction sites.

The proliferation of new laws and statutes directed toward construction equipment raises serious questions about the compatibility of those machines with the environment. Does construction equipment seriously and in large degree contribute to air and water pollution? If it does, what are equipment manufacturers doing about developing improved products to reduce pollution levels?

Some critics often count construction machines among the worst polluters. The environmentalists contend that earthmovers open up the earth and turn it into mud that

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clogs sewers and silts streams when it rains. They say the borrow sites and gravel pits dug by those machines become unsightly scars on the landscape. They say the smoke, fumes, and particles spewed out by asphalt batch plants are an intolerable nuisance and that crushing, screening, and washing processes of aggregate production plants are major contributors to air and water pollution. They point to the familiar blue-black diesel smoke appearing at times over typical construction sites and say machines powered by those engines are a source of harm and annoyance to the lungs and eyes of everyone who comes within range. They complain that the construction machines raise dust storms and create intolerable noise wherever they work.

Safety critics, too, have voiced concern about machines such as construction cranes. The big cranes that lift the heavy steel and pour the concrete on busy job sites do a marvelous job and rarely are involved in accidents. But even minor accidents with this equipment get headline notice in the press. Installing roll-over devices to protect operators of equipment such as bull dozers, front-end loaders, scrapers, and graders is a key safety issue. Soon federal law will require every piece of that equipment to be equipped with that type of safety unit.

In the current debate, how do manufacturers of construction equipment define the role they must play? The manufacturers are aware of the temporary inconvenience and discomfort created by various types of construction activity. Equipment builders recognize that construction projects can permanently alter the environmental and aesthetic values of localities. However, most of the latter problems concern land use and are properly the business of the governmental planning agencies. Similarly, good housekeeping practices on the job are the contractor's responsibility. We must leave selection of highway corridors and building sites to planning officials. For all practical purposes, we must leave choice and use of specific equipment and the environmental aspects of the specific job site to the contractors and to the local control agencies.

As manufacturers, we can continue efforts to design and build productive, long-lasting, heavy-duty machines. We can expand our concern and efforts to make them contribute less noise and air pollution and thus be less of an irritation to the community at the construction site. We can expand our efforts directed to machine safety.

How are manufacturers set up to get the job done? To do the job on a total basis is one of the prime reasons the industry joins together under the umbrella of the Construction Industry Manufacturers Association (CIMA). The association is composed of some 180 U. S. equipment and major component manufacturers who account for approximately 95 percent of the U. S. dollar volume of this multibillion-dollar construction machinery industry. The association is a central coordinating body for the manufacturing segment of the construction industry in the areas of safety and environmental performance standards; marketing data; government liaison; and liaison with other segments of the industry including contractors, distributors, and other associations.

CIMA exists because of the willing participation of its members in projects for public benefit and industry progress. Member companies have welcomed the responsibility to apply their expertise toward helping shape responsible and effective legislation and regulation that fully consider total social needs at satisfactory costs and compromises. Action taken by the association some 4 years ago to discharge that responsibility has, some believe, made it uniquely qualified to act as the spokesman for the industry in environmental matters.

That action consisted of organizing CIMA-member company experts into product-oriented committees to recognize and to promote the development of performance standards (1). The term "performance standards" refers to performance criteria for machine safety, protective devices, and the like as opposed to commercial standards that refer to capacity or production ratings or as opposed to design standards that refer to machine design. Currently there are 10 CIMA committees that represent a wide variety of construction machines and equipment.

In this entire matter of standards, completeness, clarity, and uniformity are extremely important and necessary considerations because of new, evolving safety and environmental regulations. Each new regulation can in some way influence engineering, manufacturing, and marketing procedures.

There is wide variation of environmentally oriented regulations that government agencies are writing and attempting to enforce at local, state, and federal levels. The city of Chicago in March 1971 passed an antinoise ordinance that sets specific noise limits on vehicles and machinery, including construction equipment. No construction equipment manufactured since January 1, 1972, can be sold or leased in Chicago if it produces a maximum noise level exceeding 94 dBA at a distance of 50 ft. Recently, the city of New York wrote some stringent noise level requirements into a contract for excavation of a subway tunnel under Central Park. There, the contractor must observe a maximum noise level that considers the surrounding residential character of the neighborhood. Compressors are limited to 102 dBA at 3 ft, 91 dBA at 23 ft, and 77 dBA at 100 ft. Paving breakers are limited to 104 dBA at 3 ft, 90 dBA at 34 ft, 79 dBA at 100 ft. Those are among the strictest noise controls in the country. As a consequence, a compressor or a breaker that can be used lawfully on a job in Chicago would be outlawed in New York City.

Where does that leave the manufacturer? Unless there are nationally accepted standards, a manufacturer cannot build a construction machine that is usable in all parts of the country.

The prime purpose of the CIMA committees is to promote uniform and reasonable standards that will serve the objectives of government regulation but without unnecessary confusion. Such standards permit machinery manufacturers to design and manufacture construction equipment without restrictive creative design limitations. They recognize fully any state-of-the-art limitations. They also promote an awareness of the possible resultant economic impact that the standards may have.

During 1971, 2 major events related to environmental concern occurred that vitally affect the manufacturing segment of the industry. The first was the issuance of regulations by the U. S. Department of Labor for the Safety in Construction Act that shortly after became part of the broad Occupational Safety and Health Act (OSHA). That act places newly defined safety responsibilities on all construction employers and requires special safety devices for certain equipment. The second event was the creation of the U. S. Environmental Protection Agency (EPA) and its announcement that its first major concern is the problem of construction-site noise levels. EPA is developing noise standards that may well have critical impact on equipment design and construction procedures.

The Occupational Safety and Health Act of 1970 has been called the most significant piece of federal legislation to affect the construction industry within a decade. The first OSHA regulations were published in the Federal Register of May 29, 1971, with a general effective date of August 27, 1971. The construction regulations are the same as those in the Safety in Construction Act of 1969 (7). Although the Safety in Construction Act covered only construction workers on jobs wholly or partially federally funded, the omnibus OSHA is designed to protect all workers in all industries, including construction. The U. S. Department of Labor, which is charged with administering the law, estimates that OSHA provides umbrella coverage of 57 million American workers in more than 4 million workplaces. One major group of workers not covered includes federal, state, and local government employees. Those governmental units must develop their own safety and health regulations comparable to OSHA.

In contrast to regulation practices of the automotive industry, the regulation for the construction industry designates responsibility for safe construction machines and their safe operation as defined by OSHA to be that of the employer—the owner-user of construction machines. So, the machinery requirements of contractors and their buying specifications will logically be expected to change and come to the attention of manufacturers as the impact of regulation is felt by those buyers.

It might be argued that tailoring a product to its current market is standard operating procedure; the manufacturer's basic philosophy is to be responsive to his customer requirements. Yet, in actual practice, it does not work quite that way. The research and development time requirements, the allocation of resources—people and capital, the development of manufacturing facilities, and many other factors mean that, traditionally, the manufacturer must anticipate new machinery requirements and be ready for them.

As the industry becomes more and more involved with federal regulations, manufacturers have found that CIMA's performance standards organization has provided a sound basis on which to make an effective critique of the proposed regulations and to submit industry-wide consensus recommendations to government agencies. The U. S. Department of Labor has accepted and adopted a number of CIMA-endorsed standards as part of its regulations.

To discern the actual meaning of OSHA regulations as they are currently written requires intensive, interpretive action. Frequently, it is difficult to obtain general agreement among labor department inspectors, contractors, unions, and equipment manufacturers on the intent of the regulation. Safety requirements for specific types of construction machines are often written in obscure "legalese" and located in unrelated sections of text scattered throughout thousands of pages of the Federal Register. The applicability of a regulation to a particular construction machine is often doubtful because the distinction among various equipment classes is ill-defined. There is no universally acceptable standard nomenclature for classifying construction machines.

In addition to definition problems, there are exceptions based on machine application, changes in effective dates for the regulations, and numerous amendments that a construction employer must consider before determining what he must do to comply with the law.

CIMA is attempting to relieve this confusing situation by suggesting changes in regulation format to the Department of Labor and by staging a continual thrust to use national consensus standards as the basis for future regulations. It is hoped that widely scattered regulations will eventually be gathered into one consolidated section applicable to a specific class of construction machines.

CIMA is sponsoring 2 new important projects that are under way: product requirements index for OSHA and a product classification system.

The product requirements index will attempt to pull together, under specific machine headings, all OSHA machine requirements that are now scattered and hidden in obscure, unconnected paragraphs. CIMA will present the index to the Department of Labor for checking and will strongly recommend that regulations be revised to bring the requirements together.

The product classification system will be recommended to the Society of Automotive Engineers for action; it attempts to make a determination of "families" of machines and their subgroupings. Definite identification will be assigned to each type and subtype of machine so that all concerned parties—government agencies, users, manufacturers, or standards writers—can for the first time precisely and positively identify the machines under consideration. As of now, vague terms such as rollers, earth-moving machines, and vehicles, are creating mass confusion.

Perhaps one of the most important CIMA efforts was to establish with the Department of Labor the realization that safety device requirements for construction machines could not be handled with a broad-brush approach that encompassed all existing machines and new machines yet to come off the production line. Several of the major regulations now specify different effective dates and in some cases different requirements between new and existing machines.

One prime example of this is the proposed treatment for roll-over protective structures (ROPS). When the original proposal for ROPS regulations first appeared in the Federal Register in 1971, the labor department was considering giving the construction industry fewer than 90 days to retrofit 400,000 pieces of field-located construction machinery with those devices (2). The assumption was that those devices could be added as easily as a decal could be stuck on the surface of the equipment. The wording of the regulations made no distinction between new machines coming from the factory and old machines already in use. The proposals, of course, drew sharp objections not only from equipment manufacturers through CIMA but also from other industry groups such as the Associated General Contractors, the American Road Builders' Association, and the Associated Equipment Distributors. Public hearings generated such widespread criticism that the whole ROPS question was placed on a "reserved" status by the labor department pending possible modification and new effective dates.

The types of machines affected by the ROPS proposal are crawler tractors, crawler loaders, rubber-tired self-propelled scrapers, rubber-tired dozers, rubber-tired front-end loaders, and agricultural and industrial wheeled tractors used in construction work. Those machines are, of course, designed by manufacturers with inherently good stability qualities. On many types of earth-moving projects, however, the equipment must be used over rough, steep, uneven terrain. ROPS equipment—in the form of a specially engineered steel-frame canopy or other device over the operator's conpartment—is intended to minimize the possibility of the operator's being crushed by a turned-over or rolling machine. The ROPS equipment is designed and tested to offer that kind of protection within certain practical limits of speed and grade.

As of this writing, the pending ROPS proposal requires that all new earth-moving machinery manufactured after July 1, 1972, be equipped with ROPS that generally conform with SAE minimum performance criteria. Manufacturers saw only a few major obstacles to installing the equipment at the factory, provided sufficient lead time were allowed for manufacturing logistics.

But retrofitting machines already in the field is another matter. At issue are 2 additional provisions of the pending regulations that require all existing equipment, regardless of age, to be retrofitted with ROPS by their owners by specifically designated dates. Equipment manufactured between July 1, 1969, and June 30, 1972, would be subject to a staggered schedule for ROPS retrofit during a 24-month period ending in mid-1974. Of greater concern to the industry is the even farther-reaching proposal that all machines manufactured before July 1, 1969, be retrofitted by July 1, 1975.

The main objections to such a massive retrofit program are the physical size of the manufacturing-sales-service task, the insurmountable engineering problems involved in some instances, and the poor ratio of the cost to effectiveness. The complexity of the problem is illustrated by the fact that the ROPS ruling can affect approximately 1,000 makes and models of equipment, some 600 of which are no longer in production. The total cost of ROPS installation in some 400,000 pieces of existing equipment could be close to $700 million!

CIMA members would be willing to accept a requirement that machines manufactured between July 1, 1969, and July 1, 1972, be retrofitted with ROPS. Those newer machines should present no serious problem because, in most cases, the ROPS proposed for current production machines are adaptable. However, the installation of ROPS on older machines presents a serious, if not insurmountable, problem in that those same mass-produced and adequately tested ROPS units are not readily adaptable, and the basic machine designs may be incapable of supporting the loads imposed by ROPS. Field retrofit of those older models will at best result in machines equipped with marginal, or even less than marginal, safety devices. Manufacturers also believe that retrofit of ROPS on machines having unknown capabilities may actually give the operator a false sense of security and therefore is not in the best interest of safety.

All known technical and safety facts tend to point out the fallacy of remanufacturing old machines or calling a machine safe when some kind of structure has been arbitrarily welded on it without consideration being given to the integrity of the machine to support the structure.

The construction equipment industry is being singled out by federal rule-makers to be the only class of manufacturers required to retrofit vehicles already in the hands of users. No such requirement has ever been imposed on automobile manufacturers for instance, who are only required (with generally adequate manufacturing lead time) to equip new models with safety devices such as seat belts, head rests, and collapsible steering wheels. To date, no one—including public officials, contractors, safety organizations, or labor unions—has produced statistical data or proof that an expensive undertaking like ROPS retrofit is critical to safety and worth the tremendous costs.

A survey was conducted among 2,600 American Road Builders' Association member contractors to investigate the frequency rates of roll-over accidents. The survey results totally refute previous contentions about accident and fatality rates relating to the highway construction industry (3). Nearly 1,200 completed and signed survey forms were received by ARBA, representing about a 45 percent return. Table 1 shows that, during approximately a 4-year period from 1968 to 1971, more than 26,000 pieces of

**Table 1. Construction equipment roll-over survey results.**

| Equipment | Pieces Owned | Roll-Overs | Fatalities | Hours Worked |
|---|---|---|---|---|
| Rubber-tired, self-propelled scrapers | 4,669 | 65 | 4 | 21,477,000 |
| Rubber-tired, front-end loaders | 4,770 | 27 | 4 | 21,942,000 |
| Rubber-tired dozers | 396 | 4 | 0 | 1,821,600 |
| Crawler tractors | 7,099 | 19 | 3 | 32,655,400 |
| Crawler loaders | 1,813 | 10 | 2 | 8,339,800 |
| Motor graders | 4,390 | 19 | 1 | 20,194,000 |
| Agricultural or industrial tractors | 3,095 | 14 | 1 | 14,066,800 |
| Total | 26,195 | 158 | 15 | 204,970,000 |

earth-moving equipment worked an estimated 205 million hours and suffered 158 roll-over accidents, a frequency of 0.77 accidents per million hours worked. Fifteen of those accidents were fatal. That is a frequency rate of 0.073 fatalities per million hours, a far cry from an allegation made in earlier testimony to the Department of Labor that roll-over accidents were responsible for 1,000 deaths per year in construction. The public should be aware of the extremely high ratio of cost to supposed benefits of mandatory ROPS on all earth-moving machines.

One aspect of the safety question that has gone practically unnoticed is the almost total absence of any government rule-making directed toward the operator—the person who operates the construction machine that is designed with inherent safety if operated properly according to instructions. OSHA requires the construction employer to provide a safe environment for the workman, and that responsibility is indirectly transferred to the manufacturer who provides the construction machine. But OSHA makes only passing reference to the need for operator training. It does not require the operator to have a license or to have a certain amount of experience under supervision to run the equipment.

Manufacturers have a sincere interest in operator safety. No one has ever deliberately designed and built an unsafe or half-safe machine. But machines can be and are misused through carelessness or ignorance of correct operating practices and safety precautions. Safety, like so many other matters, is a grass-roots thing. If it occurs, everyone must get involved in it—not just the manufacturer who designs a machine but the contractor who buys it and the operator who actually runs it. The safety-designed machine loaded with the best electronic or other types of safety devices can become a death trap if the operator is careless because he is tired, distracted, bored with his work, or likes to take short cuts.

Although manufacturers believe that the actual responsibility of operator education is mainly that of the contractor, they recognize they can offer technical assistance. Several years ago CIMA, as a supplement to its performance standards activities, authorized development of an operator safety manual for crawler tractors. The manual was released for distribution as a trial project in 1969 and proved to be a great success. More than 100,000 copies have been sold on a self-supporting basis to contractors, manufacturers, training groups, labor organizations, operators, and other interested parties.

The widespread acceptance of that manual as an educational and training aid in accident prevention prompted the development of others. Currently, safety manuals for rubber-tired loaders, off-highway trucks, cranes and excavators, motor graders, and rubber-tired scrapers are also available through the association. Those manuals are designed to supplement rather than replace the individual manufacturer's manufacturer's operation manuals. CIMA manuals have been widely accepted by users of equipment not only in the United States but also in other countries. For instance, the crawler-tractor manual has been translated and printed in Vietnamese and Japanese and is currently being translated into Greek. The wheel loader-dozer manual has also been printed in Japanese.

In response to demand, several of the safety manuals have also been converted into slide presentations for group training purposes; more are being converted. Here is concrete evidence that manufacturers are interested in safety and doing something about it! The efforts substantiate the contention that education, not legislation, should have top priority as the most effective way of achieving greater safety for the operator—and all workers.

Another segment of the equipment industry affected by OSHA is the crane manufacturers. The impact on those firms is not so heavy as it might have been because OSHA regulations refer to a commercial standard adopted a few years ago by the American National Standards Institute (4). That standard, covering cranes, was accepted as a voluntary industry-wide standard by members of CIMA's then independent Power Crane and Shovel Association and now a special department of CIMA.

OSHA requires cranes to be in compliance with the B30.5 standard. It specifies safety equipment such as antiskid walk surfaces on the machine platform, guardrails, wire rope guards on all drums, drum rotation indicators, boom hoist shutoff devices, and machine level indicators. Still to come are proposed regulations (adopted from longshoring crane safety rules) for approved boom angle and load measuring devices. That equipment is designed to prevent accidents such as machine tipover or boom collapse by warning the operator that he is exceeding prescribed operating limits of the crane. The prices of those computerized load warning devices start at about $2,000 and go as high as $10,000.

From the standpoint of exhaust emissions, most construction machines are not extremely large contributors to air pollution because most are powered by diesel engines. Although diesels can emit dense smoke while being revved up, the actual gaseous pollutants they give off are far less damaging than those exhausted by gasoline engines. One prominent diesel manufacturer estimates that diesel engines contribute less than 1 percent of the total air pollution burden (5). Nevertheless, engineers are working on the problem of cleaning up diesel emissions. But, until standards are set, about all that can be done is to measure the amounts of hydrocarbons, carbon monoixide, carbon dioxide, and oxides of nitrogen emitted into the air from exhausts and to improve the systems.

CIMA is not actively engaged in implementation of emission standards for engines because that effort falls quite naturally within the province of the Engine Manufacturers Association. CIMA's policy is not to duplicate efforts of other industry associations but to maintain communications with those groups in order to keep equipment manufacturers informed of new developments.

Another important area where equipment manufacturers are working is in noise abatement. Noise pollution is a factor for construction operators and workmen and for the surrounding community.

A pending congressional bill would allow the EPA administrator to impose noise standards on all construction equipment. That law will be keyed to community annoyance, not worker protection.

CIMA has published an industry position paper that placed the problem of construction machine noise into proper perspective (6). It points out that manufacturers have traditionally placed major emphasis on designing construction equipment for greater productivity rather than for quieter operation. During the past few decades, the demand of construction economics for more production at less cost from equipment has prompted the development of today's remarkable machines with more power, automation, and speed than ever before. But machine improvements that lowered production costs generally tended to raise sound levels. A major shift in goals is now beginning to take form. Scientists in both industry and government are conducting studies to determine just what man-sound relations are acceptable from an occupational standpoint and what sound exposure is tolerable at the community level.

Through CIMA, machinery manufacturers are cooperating in a joint effort among government, sound specialists, and contractors to accumulate the great masses of actual on-the-job sound data required. New and updated SAE standards and recommended practices on operator and exterior noise levels are being developed as this work progresses. In the meanwhile, industrial researchers are working to evaluate

the many sound sources peculiar to individual machines and are developing quieter components and systems for models still on the drawing board.

Although EPA is concerned with limiting construction noise from the standpoint of environmental effects, federal regulations are already in effect under OSHA limiting noise from the standpoint of occupational safety. OSHA noise regulations refer to an SAE measuring code that relates the duration of exposure to the sound level expressed in dBA. Under OSHA, sound exposure of operators and workmen may not exceed the following values (7):

| Duration (hours/day) | Sound Level (dBA) | Duration (hours/day) | Sound Level (dBA) |
|---|---|---|---|
| 8 | 90 | 1½ | 102 |
| 6 | 92 | 1 | 105 |
| 4 | 95 | ½ | 110 |
| 3 | 97 | ¼ or less | 115 |
| 2 | 100 | | |

Oversimplification frequently leads many to believe that the noise problem is created mostly by engine exhaust noises and that the solution is larger mufflers. To be sure, engine exhaust noise is part of the problem; however, reducting exhaust noise permits other machine noises to become dominant. Other noise sources that are of the same order of magnitude as exhaust noises, depending on the machine and its configuration, are internal engine noises exclusive of the combustion itself; engine air inlet; transmission and other gear noises; hydraulic system noises including pump, tubes, valves, cylinders, and hydraulic motors; air noise from the fan and radiator; and various moving mechanical elements such as crawler tracks or scraper elevators. Very likely on a large machine today each of those noises is individually more than 90 dBA. In the case of 2 equal noise source levels, the sum is about 3 dBA higher than either source alone. For 4 equal noise sources, the sum is about 6 dBA higher. In reverse, noise acts much the same way. Suppose the total noise of a machine is 100 dBA and is composed of 4 equal noise sources: exhaust, engine, gear and hydraulic, and fan noises. If exhaust and internal engine noises were reduced to zero, the machine would still have a noise level of 97 dBA. That is the challenge to the engineers who are studying each noise source and striving for noise reduction of each component.

The operator of a vehicle can now be protected from noise by simple devices such as earmuffs or earplugs. However, the operator must be required to wear them in the same manner that he is required to use hard hats, safety glasses, or safety shoes. That, of course, is a short-term solution. In the long run, the noise problem will be resolved by the manufacturer.

The economic costs of noise abatement in the general environment should be considered by all levels of government. Noise consultants warn that the increased cost of sound control is not in exact proportion to the number of decibels reduced. The cost increases much more rapidly as the required sound level drops.

EPA guidelines for air pollution control have already been issued. Enforcement through state implemented plans of national air quality standards set up in the Clean Air Act of 1970 will force many new changes in equipment design. By August 1972 every state must have enacted emission standards so that their air quality falls within EPA guidelines. The states must begin enforcing their regulations by the summer of 1975, or the EPA will step in and do the job. There will have to be drastic reductions of particulate emissions from aggregates, asphalt, and concrete plants. The guidelines also imply the possibility of dust controls on construction activities like drilling and blasting. The following steps are some that will have to be taken if EPA guidelines are met.

Contractors will be required to use dust-suppression devices on drilling operations to catch fine airborne particles resulting from cleaning drill holes with air. Highway contractors have found that detergent dust-suppression systems now on the market and costing about $200 may do the job. The process uses a small amount of detergent in

the water. Water is fed into the air stream that is used to clean the hole, and the dust particles are dampened as they are created.

To control cement particulates at concrete plants may require fabric filters, electrostatic precipitators, or other types of equipment. Aggregate storage bins may have to be enclosed to eliminate fugitive dust. EPA estimates the new control equipment needs at $110 million for installation and $30 million annually for operation.

Stringent standards for particulate emissions will require additional expensive control devices, such as expansion chambers, skimmers, centrifugal dry collectors, wet washers, or bag houses, to be installed at asphalt plants. The National Asphalt Pavement Association estimates that total cost to the entire industry during the next 5 years to implement all EPA guidelines will run close to $500 million.

CIMA has not become involved in standards activities for asphalt plants and concrete industry equipment because they are specialized fields that fall within the province of allied industry associations such as the National Asphalt Pavement Association, the National Sand and Gravel Association, the National Crushed Stone Association, the National Ready-Mix Concrete Association, and others. Nevertheless, those specialty fields are experiencing many of the same problems that face earth-moving builders or crane-excavator manufacturers.

NAPA contractors and manufacturers object strongly to a proposed new EPA air quality regulation that would reduce the maximum allowable particulate to 0.03 grains/$ft^3$ of standard exhaust gases as being unjustifiable from a technological and economic standpoint. NAPA says that compliance with the proposed regulation could cost as much as $100,000 per asphalt plant. For the small producer, that type of expenditure during a short period of time would present an unjustified economic burden that would force many contractors out of business. The hot-mix business is highly competitive. Contracts are won and lost on the difference of a few cents per ton of asphalt. The smaller producers, if forced into the huge expenditures required by impractical regulations, would have no recourse except to go out of business.

The problem areas discussed here represent only the tip of the iceberg—much more lies beneath the surface. Many environmental protection and safety regulations are untenable, uneconomic, impractical, and unworkable and will have to be solved through negotiation and compromise between governmental agencies and industry. We can also expect a multitude of similar new problems to crop up as regulations unfold. Some trade-offs must be made to determine whether the actual good accomplished by design changes for health or safety's sake outweighs total costs.

Equipment manufacturers are sincerely dedicated to the cause of safety and environmental welfare. They also feel responsibile to the people who use their products. They are concerned that customers and eventually the public do not spend money wastefully or unnecessarily on machine improvements that really do not increase safety or that may be just "band-aid" treatments that will not provide a long-term solution.

As costs of some of the proposed pollution clean-up and safety programs begin to take on astronomical proportions, it is appropriate to quote from President Nixon's message to Congress in August 1971, transmitting the second annual report of the Council on Environmental Quality.

> We should not expect environmental miracles. Our efforts will be more effective if we approach the challenge of the environment with a strong sense of realism.
>
> We must recognize that the goal of a cleaner environment will not be achieved by rhetoric or moral dedication alone. It will not be cheap or easy, and the costs will have to be borne by each citizen, consumer, and taxpayer. How clean is clean enough can only be answered in terms of how much we are willing to pay and how soon we seek success. The effects of such decisions on our domestic economy concerns—jobs, prices, foreign competition—require explicit and rigorous analyses to permit us to maintain a healthy economy while we seek a healthy environment. It is essential that we have both. It is simplistic to seek ecological perfection at the cost of bankrupting the very taxpaying enterprises which must pay for the social advances the nation seeks.
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> The work of environmental improvement is a task for all our people. The achievement of that goal will challenge the creativity of our science and technology, the enterprise and

> adaptability of our industry, the responsiveness and sense of balance of our political and legal institutions, and the resourcefulness and the capacity of this country to honor those human values upon which the quality of our national life must ultimately depend.

Despite the torrents of environmental rhetoric directed toward the construction equipment industry, manufacturers do not have to adopt a purely defensive posture. There seems to be a popular misconception about construction machines. Environmentalists who tag construction machines as being bad for ecology would be far more realistic to tag them as being indispensable tools that will protect resources like lakes, streams, and rivers by building sewers, sewage treatment plants, and industrial waste disposal systems. Those same earthmovers and excavators that dig, growl, fume, and raise dust also build the housing that the population requires. They must rebuild the decaying central cities and help solve the urban transportation crisis by constructing transit systems and bus expressways. They will replace and modernize thousands of miles of unsafe streets and highways and build new, safer airports. They will do many other tasks that contribute greatly to the health, safety, and quality of life of everyone.

Operation of construction equipment can be an annoying, disruptive intrusion into the daily habits of people who live or work near job sites. But construction work is always transitory in nature. Although neighbors are disturbed by noise, dust, and vibrations during the project, relief comes when the job is completed and the big machines move on. To obtain a certain good, a price or penalty must always be paid. Nothing gets built without construction equipment; no eyesore gets beautified, and no pollution control facilities are put in place.

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