

I: Chemical Composition Of Flyash

Element	Percent
Carbon as C	0.37-36.2
Iron as Fe ₂ O ₃ or Fe ₃ O ₄	2.0-26.8
Magnesium as MgO	0.06-4.77
Calcium as CaO	0.12-14.73
Aluminum as Al ₂ O ₃	9.81-58.4
Sulfur as SO ₂	0.12-24.33
Titanium as TiO ₂	0.50-2.8
Carbonate as CO ₂	0.03-2.6
Silicon as SiO ₂	17.3-63.6
Phosphorus as P ₂ O ₅	0.07-47.2
Undetermined	0.08-18.9
pH value	4.7-11.7

II: Particle Size Distribution for Representative Flyash Samples, in Microns

Sample No.	0.5	5-10	10-20	20-44	Total small-er than 44	Total larger than 44
1	25.0	16.6	18.5	26.0	86.1	13.9
2	32.3	16.5	12.8	2.6	64.2	35.8
3	39.1	16.8	24.0	16.8	96.7	3.3
4*	83.6	5.1	3.2	2.3	94.2	5.8
5	54.8	26.5	9.1	0.7	91.1	8.9
6**	64.0	16.1	2.1	0.1	82.3	17.7
7***	—	—	—	—	2.9	97.1
8	—	—	—	—	59.3	40.7
9	—	—	—	—	93.4	6.6

*Same as sample 3, but taken at outlet of installed mechanical collector

**Cyclone-type furnace

***Stoker-fired furnace

AIR POLLUTION *continued*

credited with the ability to raise dew-point temperatures considerably. So precipitator design must give proper weight to flue-gas properties and be capable of best operation at a temperature well above dewpoint to avoid corrosion problems.

Particle size and shape, Table II, also play a part in precipitator effectiveness. The translucent, hollow spherules present in most flyashes range from below 10 microns up to 44. The irregular-shaped carbon particles commonly called grit, resulting from incomplete pulverized-coal combustion, can be anywhere from 10 to over 300 microns in size. Their shape varies from slivers to highly irregular sponge- and lace-like material. And their density proves low, about 0.7 against the average flyash specific gravity of 2.0 to 2.7.

Fig. 2 shows the settling velocity for a spherical particle of 2.2 density in a gas temperature of 300 F, and illustrates the striking decrease in settling rate with smaller particle diameters.

Resistivity. As these particles are pulled out of suspension they build up on the electrode surfaces to form layers averaging 1/8 to 1/2 in. thick. The corona current from the high-tension wires has to pass through these layers to reach the grounded collecting plates. When the resistivity approaches the critical value of 2×10^{10} ohm/cm, sparking grows more intensive and performance falls off. Normal resistivity level, though, ranges between 10^8 and 10^{10} ohm/cm.

But certain chemical compounds, in

small quantities, act as conditioning agents. They are, however, specific for each dust, and the proper one for any new dust type is found only by trial. Research Corp over the years has disclosed and confirmed that sulfur trioxide in the quantities normally present in boiler gas serves as a conditioning agent. It holds bulk resistivity below the critical 2×10^{10} -ohm cm level.

Specifying Precipitators. With all the considerations including the above that go into good precipitator design, this information is basic in specifying this equipment: (1) desired collection efficiency (2) normal gas flow or cfm rating (3) maximum gas flow or cfm rating (4) steam flow or boiler-load rating (5) gas temperature at the precipitator (6) permissible precipitator draft loss (7) type of coal and percent ash (8) particle size and maximum percent combustible expected in ash (9) furnace and burner types (10) air preheater design (11) precipitator location in power station (12) layout of connecting gas flues.

Let's see, now, how well modern electrostatic collectors meet design needs.

Operating Problems. Even with the above basic requirements known, electrostatic precipitators in years past suffered from some relatively small but annoying operating problems. Chief among them were cleaning of collected dust from electrodes, determining the ideal operating voltages and currents, achieving effective and adequate energization. Latest designs, like the one at

Goudrey Station, go a long way toward solving these problems.

Continuous Rapping. Intermediate system of rapping electrodes, employing mechanical or pneumatic vibrators to clean off collected dust, reduces overall efficiency at cleaning time by only 2 to 3% or less. Yet the puffing this method gives off causes some public concern. So the equipment makers have had to devise a method of continuous cleaning of collecting electrodes.

They've done this with a magnetic impulse rapper system based on electric and magnetic principles, free of the objections of the earlier pneumatic or mechanical approaches. A steel plunger serving as the armature of an electromagnet delivers the rapping action. A thyatron tube and distributor switch times and controls the impulsive discharge of a condenser to excite the magnet's solenoid coil. Both intensity and frequency of rapping can be adjusted by varying the condenser voltage.

From still another practical, operating point—maintenance—this rapper unit has a decided advantage. There is only one moving part, hermetically protected against atmospheric dirt and corrosion, and permanently lubricated at the time of manufacture. Designers claim it is now possible to maintain a clean stack at 98 to 99% efficiency with no trace of puffing or clouding and at high reliability.

Operating Voltages. Industrial precipitator performance proves superior. (Continued on page 196)

Today's Designs Cut Process-Pump Costs

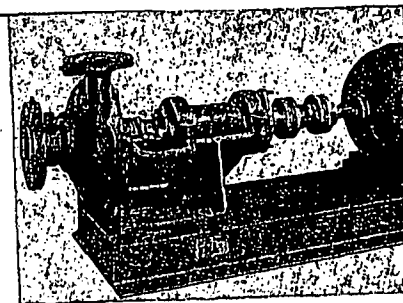
By F. G. MILFICKER, Design Engineer, Economy Pumps, Inc.

► CENTRIFUGAL PUMPS in process industries must do so many different jobs that manufacturers are carefully considering parts standardization wherever possible. Interchangeability reduces repair-parts stock, gives the pump far greater versatility.

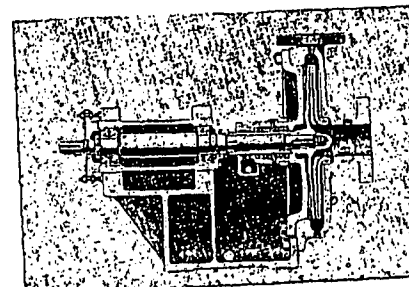
Modern Designs. Photos show some advantages gained by pump standardization. By simply changing volute covers, pump can be fitted with a cooled instead of a noncooled stuffing box. You can also change from a closed to a semi-open impeller without extensive work.

Spacer-type couplings allow removal of entire rotor after spacer is disconnected. Screws permit operator to adjust impeller position axially. Rotor servicing is simple.

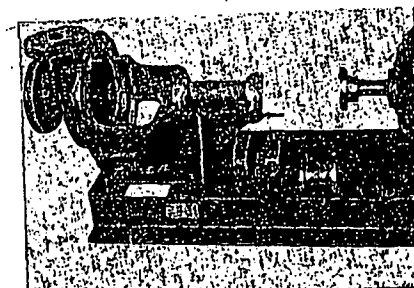
Other innovations include a single, confined casing gasket, compact cartridge-type bearing housing, oversize bearings to extend the pump's usefulness, and a gland collecting chamber that eliminates need for a drip pan. Pump manufacturers are devoting much time to study of process problems and you can expect many developments in the future.



GENERAL SERVICE process pump has spacer-type coupling for easy rotor removal. Special screws adjust the rotor axially



SECTION through general-service process pump. This unit can handle liquid to temperatures of 350 F, has replaceable parts



PUMP CASING and bearing housing bracket are undisturbed when rotor is removed. Complete rotor assembly is easily lifted

ROTOR ASSEMBLY after being lifted from pump casing. Unit is compact, has completely enclosed double-row ball bearings

