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POSECO INTERNATIONAL LIMITED



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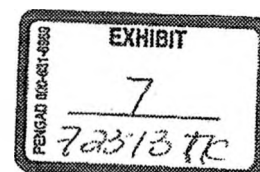
Research & Development

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TECHNICAL DIVISION

MONTHLY REPORT - APRIL, 1965

STEELWORKS PROJECTS

1. SPECIAL DEOXIDANTS

Research

(a) Steel Castings.

Complex alloys based on the Briggs formulation have been added to a steel melt in both lump form and as powder protected by a mild steel container. The resulting ingots are currently being examined and compared with a control ingot deoxidised with aluminium and silicon.

(b) Steel Ingots.

The method of deoxidation in which aluminium is introduced to molten steel in mild steel containers has been extended to larger ingots. The method again proved to be satisfactory, the resulting ingots after sectioning being observed to be fully killed. These are now in process of metallographic examination for the purpose of inclusion assessment.

2. INCLUSION REMOVAL

Research

(a) Powder Blowing Gun.

Engineering modifications to the equipment have been made and consistent amounts of powder can now be delivered. A possible disadvantage is that rather high flow rates of the carrier gas appear to be necessary. The equipment has been temporarily transferred to the Foundry Department for preliminary assessment by treatment of molten aluminium.

(b) Tablet Additions to Mould.

Experiments in which molten steel is teemed on to fluorspar in an ingot mould have been extended to larger ingots. Assessment of these is in progress.

(c) Standard System of Inclusion Identification.

A comprehensive report dealing with the origin, effects and identification of non-metallic inclusions is being prepared. This will be available for reference in the Library and Metallurgical Service Laboratory.

3. PROFAX

Research

(a) Dust Free Profax.

Trials are still awaited at G.K. Iron & Steel.

(b) Non-Toxic Fillers. etc.

Samples of olivine 4 finer than the currently used R.M.196A, and of two grogs from Bonnybridge, have been received. One of the grog samples is claimed to be quartz-free, but X-ray diffraction measurements indicate that it contains 6% quartz.

Amitac tests on Profax made with synthetic inorganic fibres showed the insulation to be slightly superior to that of production Profax.

(c) Alternatives to Paper.

Straw and chaff have been examined, but remain unchanged and floating after 2½-hours in the hydropulper. A literature search is under way to determine the manner in which straw is used by the paper-making industry.

(d) Reduction of Head Volume.

Two boxes of silicate-bonded Profax, one with wire-netting reinforcement, were poured with steel, but failed prematurely due to opening of the joints. The experiment is to be repeated, using "bridges" of CO₂ sand as supports for the vertical corners of the test boxes. A Profax assembly has been constructed with supporting ribs on the rear of the slabs. Double-walled Profax slabs have been received from A.B. Ednellhyslor for examination.

(e) Fabrex.

Further recipes have been tested by the method described in the March report, and it has been established that the maximum permissible silicate content to ensure freedom from blowing is 7%. Recipes are available for field testing.

4. DESIGN OF HOT TOPS

Research

Profax Mould Lining.

Nothing to report.

5. INGOT MOULD ADDITIVES

Research

(a) Stelotol 10 (Synthetic).

Further recipes based on pumice with various amounts of soda ash have been tested in bottom pour ingot moulds in our foundry. Examination is in progress of surface and microstructure of resulting ingots, and observations are being correlated with physical properties of recipes tested. A refractory powder that is completely solid at molten steel temperatures has also been tried, but with extremely poor results.

Our best recipe tested to-date is D.R.643. Results in the field indicate that this provides a cover similar to that obtained with Thermofin 50X and an ingot surface which compares favourably with that achieved with Stelotol 10.

(b) Stelotols 20 and 50.

Field testing of the high temperature version of Stelotol 50, D.R.659, is still awaited. An alternative means of igniting Stelotol 50 has been developed, using a special fuse which prevents extinction of combustion during application.

A visit has been made to Fosco S.p.A. and a Stelotol 50 recipe based on Italian raw materials formulated at the Marcallo Works.

(c) Coating of Metal Stream.

Nothing to report.

6. ANTI SCALE PAINTS

Research

(a) High Temperature Paints.

The search for a silicon carbide-free water-based coating is nearing conclusion. Bauxite had proved to be a successful base for such a paint, but because bauxite is a mineral of variable composition,

aluminium hydroxide was considered as a substitute. The new aluminium hydroxide-based paint will shortly be released for field evaluation.

(b) Low Temperature Paints.

Development is proceeding of a water-based paint using borax/KBF₃ as the low temperature sintering agent. First indications of tests conducted on cast iron for 16 hours at 850°C are that scaling protection is at least 90% and decarburisation is prevented.

(c) Applications.

Present A.S.P.'s are insufficiently tough to withstand much of the heavy handling they are likely to encounter in the field. Means of containing them in grease or paint films are under consideration.

(d) Mechanism.

(i) In controlled atmosphere tests at 1150°C, wet air containing 1.5% SO₂ gives more rapid scaling of uncoated samples than wet air alone. However, E.P.2507-coated test pieces withstood these conditions satisfactorily.

(ii) Permeability tests indicate that a film of E.P.2510, previously heated for an hour at 1150°C, is slightly less permeable than E.P.2507 treated in the same manner. Results of replicate experiments show reasonable agreement, but so far insufficient data has been collected to draw any inference regarding the significance of permeability.

(iii) A recording dilatometer has been constructed.

(e) Competitives.

Foliac (a graphite suspension in I.M.S.) and Dow Corning 200 (a silicone oil) were examined. Both coatings completely failed to prevent scale formation.

7. HOT TOPPING COMPOUNDS

Research

(a) Schmelzit.

Nothing to report.

(b) Fonderit A.C.23.

The thermal properties of this product have been compared with those of its nearest copy using Fosco raw materials and with conventional

Ferrux formulations. Ferrux 40 is its closest match and cheaper formulations are also being assessed. Dry powder flowability of Ferrux recipes is reported to be inferior to that of Fonderit materials, and our product has to be spread over the metal surface. Experiments are in hand to improve this property by using additions of mica.

8. CONTINUOUS CASTING PROJECTS

Research

(a) Grain Refinement of Steel.

Nothing to report.

(b) Refractory Head.

Shelton Iron and Steel have contacted Fosco (F.S.) Limited, with a view to co-operation on this development.

(c) Refractory Erosion.

(i) Self Fired Refractory.

Following the conclusions of the Fulmer Research Institute reported in March, samples of both fused and dead burnt magnesite have been sent to B.C.R.A. for examination of contraction behaviour at 1700°C.

(ii) Coatings.

Tests in our foundry indicate that coatings containing green chromium oxide are fairly satisfactory. However, better results are obtained by the addition of calcium chromate and aluminium to the coating. Work continues.

(d) Steam Film Formation.

Practical experiments have been carried out using water containing various additives including substituted hydrazines and ureas to cool molten aluminium. Macro-examination of cast samples shows a marked reduction in length of columnar crystals at the surface cooled by treated water, indicating an improvement in heat abstraction. Work continues.

(e) Mould Lubrication.

(i) Oil Methods.

Experiments have been carried out in which rape seed oil has been applied to a metal surface at 1200°C. Observations indicate that the lubrication achieved with this product is entirely gaseous, and that olive oil may be a suitable alternative.

(ii) Slag Methods.

A trial has been carried out at Round Oak Steel using a synthetic slag copied from that used at the German plant at Dillingen. Results were inconclusive. Work on this project is also being carried out on a laboratory scale, using formulations derived from synthetic Stalotol 10 recipes.

9. BOTTOM PLATE DRESSINGS

Research

A new project has been opened to devise a means of treating the bottom plate of an ingot mould to reduce wear and the incidence of finning. Two possible solutions are being considered:

1. Possible formulations for a refractory dressing are being examined.
2. Laminations of mild steel sheet and paper have been constructed to fit between the bottom plate and the ingot mould. These will be tested in contact with a stream of molten steel.

FOUNDRY AND WROUGHT DIVISION

1. PADDING

Research

Nothing to report.

2. SAND ADDITIVES

Research

Considerable data has been compiled on the effect of E.P.1898 on sands containing clays other than western bentonite. In general, little major variation in sand properties is apparent.

Of the polyacrylamides other than Bonaril 11 examined, Separan MP10 and Separan PG2 showed promise as anti-scabbing additives. All are manufactured by Dow. Data on relative costs of these materials is being obtained.

Only marginal differences in green properties are apparent when E.P.1898 is added as a solution compared with normal solid addition. Dry properties are worsened. Concentration of the solution has little affect. E.P.1898 appears to improve the properties of a mixture of old and new sand.

When added to a 14% clay slurry as used by Fords, E.P. 1898 increases the viscosity to an unacceptable extent.

Development

E.P. 1898 in Steel Foundries.

Progress with this product is considered to be very satisfactory. Some twelve British steel foundries are still continuing with trials aimed at achieving unit sand working; in some cases the maximum practicable addition of returned sand has been reached and these foundries are now able to calculate their possible savings using this E.P.

For the period under review, 147 cwts. E.P.1898 were ordered in the U.K. compared with 67 cwts. over the previous two months.

Anti Finning Additives, E.P. 2596 and D.R. 601.

Progress is slow and generally not very exciting with this project. It has been established that E.P.2596 is capable of reducing or eliminating finning on grey iron castings when used in oil sand cores: the same appears to be the case for D.R.601. Both materials, however, have given rise to a mottled cast surface appearance and as a result, the

unexpanded perlite has been sieved to eliminate the +40 mesh fraction. Since this change in formulation no further complaints of mottled surface have been received.

An interim report on E.P.2596 has been issued and the material has been released for general sale in the U.K. on oil sand cores only. The response to-date has not been very encouraging. On resin sands, where the finning problem is more severe, neither material has been completely successful, although properly controlled trials are still awaited.

Coal Dust Replacement.

Satisfactory trials have been carried out with D.R.654 at four foundries before objections were raised by Qualcast to the high wood flour content of this material. After considerable laboratory effort, D.R.661A has been developed which contains no wood flour and Qualcast have agreed to a test run of one week involving 8-tons of sand daily which will contain no coal dust, but only D.R.661A. It is most probable that D.R.654 will now become redundant.

Breakdown Agents (E.P.2497 and E.P.2499).

Steel foundry trials confirmed by laboratory work indicate that E.P.2497 is inferior to Dexil 11 and that E.P.2499 is about equivalent to the standard Fosco product. In view of the unfavourable raw material price comparison no further work will be undertaken with either E.P. and the project is now considered closed.

Liquid Sand Process.

The G.K.N. Group wish to initiate trials at the Dowlais ingot mould foundry. They had already tested the B.C.I.R.A. technique on a small scale and wished to compare it with ours. The demonstration using a Vortek mill was satisfactory and a good casting with excellent breakdown was produced. G.K.N. personnel were very favourably impressed. A full testing programme has been provisionally drawn up depending on the availability of suitable mixing equipment.

Corbicol.

Mr. J.Beale visited the manufacturers of this potato starch. From laboratory work, this material which can be obtained in many countries, is equivalent to Mixad 61. Discussions are continuing and 5-tons of Corbicol have been ordered for field evaluation.

3. INOCULATION

Research

An intensive programme of work has been carried out to establish a technique of inoculating cast iron in the mould. Various methods have been tried and assessed by measurement of chill reduction. Promising results have been obtained using tablets of paraffin wax containing ferro silicon introduced into the mould cavity and paper coated with ferro silicon inserted into down-sprue. Loose powdered ferro silicon introduced to the mould cavity has given variable and inferior results, and unsatisfactory chill reduction was obtained. When a technique has been established, it is proposed to extend the work to an examination of formulations devised by Short Term Development Department.

4. FLUX WASHING

Research

(a) Solid Filter.

Nothing to report.

(b) New Flux Washing Tank.

Extensive programme of work has continued. No advantage has been found by pre-melting hygroscopic sodium-free fluxes in the tank and it is unlikely that such formulations will be acceptable. Examination of non-hygroscopic formulations based on S.P.2074 is being made. Loss of magnesium from strong aluminium alloys which occurred when using this flux in the old flux washing process is unlikely to occur to the same extent in the new tank.

Development

The final results of trials carried out at H.D.A., Distington, with magnesite granules and Filtrox 1 in a flux washing crucible have now been obtained. The average inclusion counts of three trials is as follows:-

Filter only	17 oxide inclusions per field on three sections of extruded T bar.
Filtrox 1 and Filter together	15 oxide inclusions per field on three sections of extruded T bar.
This compares with normal material without special treatment.	37 oxide inclusions per field on three sections of extruded T bar.
Chlorine degassed metal but not filtered.	3 oxide inclusions per field on three sections of extruded T bar.

5. NUCLEANT/GRAIN REFINER

Research

This project has been transferred from Short Term Development Department. Work will be directed towards development of a product which utilises our theoretical understanding acquired to-date and matches the Kawecki hardener in ease of application. Examination of the powder blowing gun as a means of introducing a grain refining agent to an aluminium melt has commenced.

Development

Grain Refiners with high (20:1) Titanium : Boron Ratios (D.R.629 and 639).

Trials at the Aluminium Corporation, Dolgarrog, indicate that both development recipes are superior to Nucleant 2 when used at a rate of 2-lbs. per ton on 99.5% aluminium for chill cast slabs. The grain size was found to be finer and more uniform and the anodised finish superior. D.R.629 (with hexachloroethane) was preferred because of the objectionable cross obtained with D.R.639.

Grain Refiner containing only Boron (D.R.646).

Trials have been carried out on a number of aluminium foundry alloys and satisfactory grain refinement has been obtained by additions as low as 1 oz. per 100 lbs. Further tests are still required.

6. FINE GRINDING

Research

An interim report dealing with work so far carried out on coke and coal based dressings has been circulated to interested parties.

Durrans 10 is found to give an X-ray diffraction pattern similar to that of R.M.170. The water solubles contain sulphite lye, and it is possible that there may be a small amount of polysaccharide or related substance which would account for the superior suspension properties of Durrans 10 over a coke/sulphite lye mixture prepared by us.

Mixtures combining coke dust, coal dust and Phurnacite flash have been prepared for testing.

A suggestion has been made that Durrans use an edge runner mill into which they charge all their raw materials. The effect of such a technique on suspension properties is under investigation.

7. DEOXIDANT - FOUNDRIES

Research

Nothing to report.

8. DIE COATINGS

Research

Field trials of D.R's 655 and 656 have been arranged at Delta Diecastings.

9. COATINGS FOR SAND MOULDS

Research

The relative efficiencies of various binders for coatings are being examined and an apparatus to measure the abrasion resistance of coatings is under construction. A visit has been made to B.S.C.R.A. to observe tests in which ferro-static pressure is simulated by applying pneumatic pressure over the surface of metal in a mould. It is anticipated that our standard method for assessment of coatings can be further improved by this technique and a similar apparatus is to be constructed.

Development

Coatings based on Chromite Flour (DR.647, DR.648).

A number of successful trials have now been conducted and in all cases the results are equal to or superior to the equivalent zircon or chromite sands. It is hoped to broaden the scope of the trials and publish the information abroad, so that Fosco companies can take advantage of the present zircon shortage.

10. COREBINDERS

Research

Two field trials have been carried out with D.R.660, but so far no reports are available on breakdown properties of the sand. Cores produced were slightly friable and this may necessitate modifying the recipe. This project is being extended to include an assessment of all potential systems able to function as sand binders.

Development

"N" Process (D.R.'s 884, 884A and 660).

Further trials have been carried out with the silicate (D.R.884) and hardener (D.R.884A) supplied by J. Crosfield and the latter has been compared with a hardener (D.R.660) developed by Fosco. The present position can be summarised as follows:-

D.R.660 appears to be equivalent to Crosfield's hardener (D.R.884A). The scope of field trials is now being extended to gauge the market potential and to assemble the information required before such a process is introduced overseas.

11. FOAMED SAND

Research

(a) Both Teepol 514 and Teepol 610 have proved good substitutes for Empicol TLR as foaming agents. A premixed product comprising Teepol 514, n-nonanol and calcium metasilicate has been issued as E.P. 2709A.

(b) Mixers

i. A petrol driven concrete mixer with variable speed has been hired and gives better results than the constant-speed electrically driven concrete mixer tried last month. Foaming can be produced at a reasonable water level, but performance is still erratic.

ii. The 5-kilo Fordath mill has been further speeded to 80 r.p.m., which has further improved its foaming action. A mill so modified would be suitable for field demonstrations.

iii. Providing the Vortec mixer with a heightened paddle assembly has not improved its action. Speed is far too high, and reducing it to the order of 60 r.p.m. would prove a difficult and expensive undertaking.

iv. A spiral ribbon mixer has been tried and gives excellent fluidity.

Tests with the Fordath mixer/slinger have not yet taken place.

(c) Formulation, etc.

i. It is established that a permeability of 300-400 A.F.S. units is developed after $2\frac{1}{2}$ hours.

(ii) A reproducible fluidity test has been devised, based on allowing the mixture to escape through a two-inch hole in the bottom of a two-gallon tin. However, it has been established in the course of this work that the density of the mix is an all important factor being inversely proportional to fluidity and proportional to final strength. A minimum density of 1.3 gm/cc., controllable by anti-foam addition, is required for adequate strength. Curiously the densities of a mix in foamed and set states are identical.

(iii) Failure of some mixes to harden was encountered, and was traced to an off-specification batch of R.M.304, which was low in SiO_2 : Na_2O ratio and in total solids. When this was allowed for in formulation, normal hardening times were restored. There are indications that sodium silicate of 2.8 - 2.9 SiO_2 : Na_2O weight ratio give the best results. Silicate samples of various ratios intermediate between 2 : 1 and 3.3 : 1 have been received from Crosfields and are being assessed.

(d) Demonstrations were given on our premises for personnel from Jackmans and Fordath, and our first outside demonstration was given at G.K.N. Group Research Department, Wolverhampton. Both the demonstration and the subsequent casting were satisfactory, and we have been requested to produce a 6-ton ingot mould at their Dowlais works.

12. PROFAX IN STEEL FOUNDRIES

Development

Arrangements have been made to carry out trials with hand-rammed E.P.2311 sleeves (10" and 12" ID) at Jesson-Saville when compared with Feedex 50 and Feedex 723. In addition, it is hoped to be able to carry out trials with the centrifugally spun sleeves produced at Tamworth, in order to determine the comparable feeding efficiencies of exothermics and insulators.

NOTES FROM ASSOCIATED COMPANIES AND OTHER
PROJECTS

EXOTHERMICS

PROFAX

Development - Fosco Inc.

Excellent progress continues to be made with the setting up of raw materials for ball mill dust Profax production. It now appears that even high chloride materials, such as R.M.139 could be used, at a pinch, although chloride contents of this level (27%) are undesirable on account of the heavy fume evolved during burning. The need now is to press on with field trials of the product and as a first step in this direction, a number of 18" O.D. sleeves were made up during the month for trial at foundries in the Birmingham, Alabama, area.

Foundry Use.

This month has been devoted to examining samples of ball mill dust. Samples have been received from Welland Chemical, Aluminium Service Company, Rock Creek and U.S. Reduction. Of all the samples tested, only the Rock Creek fines (75% -325) presented any difficulty in manufacturing.

A test mix was made using R.M. 139 ball mill dust. Very strong fumes were given off from the slurry, but no mechanical difficulty was encountered and the blind riser burned in two minutes and thirty seconds. Some obnoxious fume was emitted.

The material received from U.S.Reduction looks very good, except that the sensitivity is slightly low. Tests showed that this could be increased by the addition of 1% of 7A to the slurry.

Development - Fosco S.A., France.

The tests at Vireux Molhain have given satisfactory results and an order for 500 sets has been placed.

Mouldable Profax - EL.90.

A recipe has been developed with expanded vermiculite base (21) and Lafarge cement. This recipe gives good results on the Amitec and in

the copper foundry. A test on steel has been attempted giving a good surface condition and good stripping, but unfortunately, we have had difficulties in shooting these sleeves on the Röper machine. Tests are at present in progress in order to reduce the grain size of the vermiculite which would be the cause of the trouble on the Röper machine.

Development - Fosco (F.S.) Limited.

Silica and Asbestos free Profax.

Tests have been carried out using grade (4) olivine sand from Norway, and to-date this material looks completely acceptable as a filler for Profax. A 25-ton consignment of this material is due in this country any time now and further work will be continued as soon as the material is at Taworth.

Two samples of mineral wool have been evaluated as possible replacements for asbestos L.M. 319; mixes have been made using both samples in concentrations of 1, 2, and 3%. Green strengths increased with the higher percentages, but there was little difference in transverse strength. Only one sample has been tried on Amitac, which gave superior results to that from current Profax.

Four samples of chopped fibreglass have been received and have been successfully evaluated. However, these materials are very much more expensive than asbestos.

FEDEX

Development - Fosco Inc.

Reformulation of most of the standard range of Fedex to deal with the current shortage of grindings is now almost complete. In the main, this has been accomplished without much disturbance of the quality of production, although some minor variations such as in the water requirement will be apparent in some cases. It is to be expected that some complaints will be received from the field, and that some further minor adjustments to the recipes will be required in the light of experience.

Work on American Steel Founders' Society.

Although our test results have not as yet been able to fully substantiate Fosco International's claim that English padding recipe No.3 gives consistently improved bend tests through lower aluminium silicon contamination, there are some indications that the hypotheses of

aluminium combined with sulphur as the main cause of the embrittlement may eventually be substantiated.

FERRUX

Development - Fosco S.A., France.

Ferrux 40.

In the last batches of Ferrux 40, we had to reduce the percentage of R.M.3 by 50%. We had thought that the main constituent of Ferrux 40, the calcined alumina, was responsible for this reduction, but after various changes in the alumina, this Ferrux was still very rapid. Tests have indicated that the grain size of the nitrate affects the sensitivity of the product.

Ferrux without fume (121L etc.)

This problem is at present at the forefront. A test at Mont St. Martin of Ferrux EL.2754, has given excellent results from the point of view of fumes, but unfortunately, the product swells considerably, collapsing on itself during cooling and adhering to the ingots after stripping.

KALMEX

Development - Fosco S.A., France.

Kalmex I GS.

Tests are at present in progress on the grain size of this product in order to obtain a more uniform product.

We have established that after packing into sacks and after having undergone a journey, considerable changes in the times of ignition and combustion of this product are observed, without appreciable change with regard to the grain size and the density of the product. This abnormal phenomenon would indicate a second control.

EXOTHERMICS

Development - Fosco(F.S.) Limited.

Alternative production methods for exothermic sleeves by centrifugal spinning suction filter, etc.

Considerable effort has been put into producing exothermic sleeves by spinning techniques. A recipe containing 86% R.M.422D low, 4.5% R.M.267, 4% R.M.389A and 2.5% exported 75 has been found suitable

for spinning. A slurry containing 40% solids has been made at a 1 gall. mix and produces a sleeve with a wall thickness of 0.6" and negligible taper. Increasing the slurry addition to 1½ gallons (maximum capacity of this spinning chamber) gives a wall thickness of 0.7". Sleeves made from this recipe have been sent for field evaluation. Indications are that during the drying process of these sleeves, a reduction of 2-3% in the outside diameter of the sleeve occurs. The effect of reducing spinning time is also being studied and initial tests indicate that spinning times could be reduced to approximately 30 seconds, and possibly further without much significant increase in water content.

MOULD COATINGS

Terrapaint Development - Fosco Inc.

During the month of April, 107 batches of Terrapaint 55M were produced. No batches were found to be defective. Thus, it would appear that the change to pre-gelled bentonite combined with careful control of pH has completely eliminated the free liquid problem. The results of the shelf-life tests on these batches are not yet available, but preliminary indications are that the majority of the compaction troubles have also been eliminated.

Stelotol Development - Fosco Inc.

Stelotol 50.

A sample of a new gelling agent was received from the present supplier of aluminium octoate. This product did not gel as fast as X.1581, but when it finally did set, it formed a rather stronger gel. A larger quantity was ordered to make up a test batch for field trials.

Tests at Copperweld indicated that our present Stelotol 50 may give very poor deposits under certain conditions, i.e. tight moulds and poor air supply. E.P.2619/STL tested under similar conditions gave very good results. Because of the relatively poor performance of Stelotol 50 at Copperweld, present stocks were examined to see if they were up to par, or whether performance might have fallen off. Extensive tests revealed little, if any, detectable change. Final conclusions were that laboratory tests may bear little relation to field performance under some conditions.

Seventeen new raw materials were examined for suitability in improved Stelotols. Two of these, Hi-flash naptha (Ohio Solvents) and "Cydosol 33" (Shell Oil) have been selected for further study of partial

replacements for kerosene and xylene now used. Both gave much heavier quantities of soot evolution for a given weight than kerosene, and have higher flash points than xylene.

A list has been compiled from the literature of 21 organic compounds, which yield from 25 to 85% carbonaceous residue when burned. These materials are mostly multi-benzene-ring structures, modified by various functional groups and with high molecular weights. Nitromethane and nitropropane may offer a partial solution to formulating Stelotol gel which will burn in an oxygen-poor atmosphere. Both compounds have O.C. flash points above 100° F. Their compatibility is excellent with other Stelotol components as well as a large number of other organic materials.

Tests to establish the composition of the deposits produced from Stelotol 50 showed that regular Stelotol 50 yielded a soot containing 94% carbon and 3% hydrogen and E.P.2619/STL (containing xylene) yielded a deposit containing 96% carbon and 4% hydrogen. E.P.2619/STL gave an O.C. flash point of 92° F compared with 120° F for regular Stelotol 50.

Stelotol Development - Fosco (F.S.) Limited.

Development of a foamed Stelotol 20 to improve and reduce spitting in the mould.

This project has been tackled from two aspects, the first to expand polystyrene and mix together with the resin and bond to form low density tablets. The second to introduce Stelotol 20 to expandable liquid Polyurethane resin again to produce a low density of rigid spongy material. The most successful method of mixing Stelotol with foamed polystyrene has been to wet Stelotol with I.P.S.1 and then mix the required quantity of expanded polystyrene. The dissolved resin gives a firm bond allowing the material to be rammed into a container that is sealed and ready for use.

Several recipes have been produced by foaming Stelotol 20 powder in Polyurethane; the maximum quantity of Stelotol which can be incorporated into a mix is 37.5%. The density of this material in its foamed state has been found to be 0.143 g/c.c. Samples have been prepared and are available for field evaluation.

Self-drying Moldcote for Iron Castings - Fosco International Limited.

One trial has been carried out, applying this coating on top of Moldcote 6 for large ingot mould cores and moulds. Some improvement was observed over Moldcote 6 alone and further trials are promised. The fumes have been objected to and these will probably have to be masked.

Development of a Dressing similar to Thiem Satinkote - Fosco (F.S.) Ltd.

Although trials with D.R.869 have not been completed by Ford as yet with this material, which is being offered in competition to Satinkote, it has been renamed E.P.2718/TP for costing purposes.

Development of Improved Hot Box Coating for Ford Motor Company - Fosco (F.S.) Limited.

Verbal comments from the Ford Motor Company indicate that agglomerates of powdered material are still present which render the coating difficult to use. Ford also express a desire that the viscosity curve of the dressing should be flattened within the 15-16 second range. The covering power of this coating was found to be from 23-24 (a Ford Motor Company standard) and is satisfactory for their use. Work is continuing with this project.

Comparison and Evaluation of South African Coke Blacking and Morgan Blacking Fosco (F.S.) Limited

23 drums containing two types of blacking have been sent in by G. & W. Base Minerals Limited. There were two types available in these 23 drums, the only difference being the grades of coke used.

All results so far tie in well with those obtained on the previous small samples, apart from the self-severe applied coating.

A similar series of tests have been carried out with a blacking obtained from the Morgan Crucible Company Limited again to compare its properties with Durran's 10. Findings to-date are that this Morgan material is coarser than the South African, but slightly finer than Durran's. It has the following mesh grading:-

9% +200
11% +300
Balance -300

Coating tests revealed that the material had a similar hardness characteristic to Durran's 10. Test castings have been prepared and are at present being shot blasted prior to examination.

Development of a Coating to compete with Durran's Steelmol 15 - Fosco (F.S.) Limited.

This product has had satisfactory field tests, but British Roll Makers Limited have at the same time carried out gas evolution tests on this dressing and compared their results with Durran's 15. Discrepancies between results obtained by ourselves and British Roll Makers are believed to be due to differences in procedure. Our apparatus is, therefore, being modified to overcome these discrepancies and further tests are being carried out.

Development of Synthetic Dycote 11 - Fosco (F.S.) Limited.

D.R.761G has been evaluated but faulted in that it adhered too well to the die face. This was presumably due to the 1% R.M.110 addition. A further D.R. has been issued containing 0.24% R.M.110 and without any R.M.110 being present and these are currently being evaluated.

Dry Powder Spuncote for Grey Iron Liners - Fosco (F.S.) Limited.

Attempts to use the grades of calcined anthracite mentioned in last month's report to eliminate ferro silicon at Harold Andrews Limited, Halesowen, have been unsuccessful but the present grade of anthracite is much superior to previous consignments and the introduction of ferro silicon to this has given very satisfactory results. Production trials with E.P.2696A/SCT are now in hand.

SANDS & COREBINDERS

Corfix Development - Fosco (F.S.) Limited.

Modification of Corfix 40 for Morris Motors, Wellingborough.

As a result of a successful trial with D.R.754/CFX, this material has been renamed E.P.1566F and the above company have placed an order.

Coreseal 4 Development - Fosco (F.S.) Limited.

A thinner version of E.P.2590A/CRS has been prepared and has been called D.R.287E/CRS. Work is also in hand to study complaints made by customers regarding the quality of E.P.2590A.

Evaluation of B.N.F. Process 34, Glucose base Breakdown Agent - Fosco (F.S.) Limited.

A considerable amount of time has been spent in evaluating this process and our findings have been published in Technical Report No. UK.42. Briefly conclusions were as follows:-

1. Process 34 justified the claim that it facilitates breakdown and core knock-out without adversely affecting physical and mechanical properties of cores.
2. At conventional levels of sodium silicate, i.e. 3%, cores are no better than those containing Dexil 11 at the same level of addition, i.e. 1%.

3. At reduced levels sodium silicate binder, i.e. 2%, Process 34 allows manufacture and use of cores which are otherwise impracticable, therefore, knock-out properties are excellent with both copper and cast iron.
4. At these reduced levels of silicate binder, satisfactory cores cannot be made with Dexil 11.
5. Process 34 enables a saving to be made in the cost of silicate binder because of the small amounts used.

Generally, Process 34 is and may be classed as rather a sodium silicate binder extender, rather than a breakdown agent.

Mixad Development - Fosco (F.S.) Limited.

Mixad 61 is now being used on a regular basis. It has taken approximately six weeks to show that the addition rate of Mixad 61 for this particular plant, purely as a replacement, is between 4½-6 cwt. per day. A detailed scrap analysis over the months of March and April indicates that some saving may be expected following the considerable reduction in expansion defects. An improvement has also been observed in the casting finish.

Corfix Development - Fosco Inc.

In view of the excellent results and sales in Mexico of Corfix 4, it was decided to try this product. Tests were run with Corfix 4, Corfix 40, and a powdered version of Corfix 4. Respective tensile strengths were 225, 110 and 165 p.s.i. In view of the relatively low raw material cost and the results obtained, it was suggested that this product be evaluated in the field.

FLUKES

Zinc Coveral Development - Fosco Inc.

Improved Zinc Coveral for General Use.

Since General Motors, Trenton, New Jersey, have already tried Zinc Coveral 87 in the past, it was decided to try the new English high temperature recipe. Experiments in the foundry indicated that R.D.581 (E.P.2621) flux would work well, without giving noticeable fumes at a temperature of 950°F. A sample was submitted for trials early next month.

TREATMENT OF MOLTEN METALS & ALLOYS

Dry Cuprex (E.P.2493) - Fosco International Limited.

Development

Trials have been completed and a summary of field experience and recommendations is being prepared. It is considered that E.P. 2493 in both powder and block form is technically at least as good as, if not superior to its standard Cuprex equivalents, and in addition, it has a raw material price advantage. It is intended to seek approval for this product at the next approval committee meeting prior to releasing the trial information abroad.

Anti-Fading (Permablock. E.P. 2734 tablets. Coveral 64) - Fosco International Limited.

Development

It has only been found possible to produce small (4-oz.) tablets of E.P. 2734 and Coveral 64, and for one trial these were glued together with sodium silicate and dried in order to compare the materials directly with the prefused Permablock. The latter prevented reversion successfully for two hours, whereas, the other tabletted materials were only satisfactory for half that time. Attempts to press E.P.2734 and Coveral 64 into blocks on an 800-ton hydraulic brick press produced blocks which were so delicate that they could not be handled. Work will, therefore, be concentrated on the prefused Permablock.

Albral type Flux not containing either Fluorides or Boron (D.R.65E - Fosco International Limited.

Development

At J. Stone & Company, one trial with 14% manganese bronze has been completed. Flux characteristics and melting losses were the same as for Cuprit 1. Providing metal is free from hard spots, trials in the large reverberatory furnace have been agreed.

FOSECO - FORDATH

The FPR/17 resin is meeting with considerable success in many of the larger foundries in the country. An improved catalyst system containing a much lower nitrogen content has been developed for use with FPR/17. This will reduce the possibility of pin-holing even further.

The cold-set equivalent to FPR/17, which is to be named CS. 60, has now been successfully completed, and field trials are at present being conducted. Early indications are very promising, and it is hoped to release this product for general sales in the immediate future. It should be noted that this is not completely furfuryl alcohol free, but contains a substantially lower percentage than other cold-setting resins.

A sample of HB31 manufactured by Adryzyl, Brasil, has recently been received, and is being evaluated by the Fordath Engineering Company.

TECHNICAL SERVICE

Miscellaneous Short-Term Development.

(a) Pickling Inhibitors.

The size/Teepol inhibitor manufactured by G.F.Powell(E.P.2661) was only slightly effective at the recommended concentration of 0.1%; it permitted considerable metal loss together with heavy staining. At 1.0%, inhibition was improved to 81%, but staining persisted. A further very slight improvement resulted from increasing the size/Teepol ratio. The competitive Armohib 25, at 0.04%, gave 96% protection and a bright finish.

Dowfax 2AI, a commercial detergent, had some inhibiting properties and formed a stable foam on the surface of the bath, thereby suppressing acid spray. At 1% it gave an inhibition of 79%, with metal staining. A mixture of 1% Dowfax 2AI and 0.01% phenylthiourea gave 90% protection and a bright finish.

All the inhibition figures are for 20% H_2SO_4 at 90°C.

(b) Development of Inoculin for High Strength Irons.

Further experimental foundry trials give continued confidence in R.M's X1483 and 115C. in respect of both chill reduction and tensile

strengths. In respect of tensile strength, the combination of the two R.M.'s on a 50/50 basis is particularly encouraging and a recipe for field trial which includes this combination is being considered.

The single field trial already conducted with R.M.X1483 and reported last month as not having given the high degree of chill reduction expected has, after all, produced generally encouraging results. Chill reduction can be described as adequate only, but tensile strengths obtained were higher than for Inoculin 10 used under similar conditions.

(c) Steel Terrapowder for Suspension in Water or Alcohol.

Tests are being finalised with a recipe which differs from other existing Terrapowders in this field, basically in that chromate flour is the filler and colloidal silica is used to give quite good suspension properties in alcohol.

(d) Works Control of R.M.252 Solution Viscosity - Terrapaint 55.

Currently, the I.C.I. Rotothinner is recommended for this purpose. It has been thought that some of the smaller companies may find this instrument too expensive and consequently, efforts are being made to construct a cheaper but adequately reliable apparatus. One such apparatus has been prepared, but may require modification before its suitability can be assessed.

Companies who are interested are invited to write to Technical Service Department.

(e) Grain Refinement of Magnesium Base Alloys.

A Technical Service Report on the use of calcium cyanamide has been issued.

(f) Terrapaint 55.

The reported suspicion that R.M.239 effects breakdown of R.M.252 gels, apparently substantiated last month, has been further examined. Substantiation appeared to come from tests in which a concentrated R.M.252 solution was diluted with water and R.M.239 solution. The latter produced substantially greater decreases in viscosity.

Subsequently, batches of Terrapaint 55, with and without R.M.239 solution were prepared. Better suspension properties were obtained where R.M.239 had been used. There is some agreement here with the comments of a U.K. manufacturer of R.M.239, who says that its advantageous properties as a dispersion agent should outweigh any deleterious effects on R.M.252 solution.

(g) Moldcote 33.

The claim of Foseco, Australia, that the use of R.M.408 instead of R.M.129 in bentone gel improves storage/transportation (suspension) properties of Moldcote 33 has been upheld in laboratory tests. Foseco (F.S.) Limited, Foseco Espanola S.A. and Foseco G.m.b.H., who have all expressed recent interest in this field recently will, it is hoped, comment shortly on their findings.

(h) Mixed 61.

1. A sample of material for potential use as R.M.269 in Mixed 61 has been examined for Foseco, Italy. It was found to be of some value but not up to the standard of U.K. R.M.269.

2. Five samples of potential I.M.269 were examined for Foseco Inc. Only one appeared of any great value and this was not completely up to standard.

3. R.M.269Z from Foseco, France, has been examined with satisfactory results.

4. Tests are in progress to reproduce a metal/mould reaction with L.M.4 aluminium alloy which has been reported in the field where Mixed 61 is used in the moulding sand. There are some small signs of success and the phenomena will be studied in conjunction with Foseco (F.S.) Limited.

(i) Inoculin 10.

Two samples of Inoculin 10 from Foseco, Germany, which contained slightly coarser than recommended graphite, have been examined. Because the graphite was of very good quality, the oversize grading was considered tolerable when normal supplies were not available.

Two samples of R.M.427B have been examined for use in Inoculin 10. Both are already in use. One material from Foseco, France, was felt to be not quite up to the standard of U.K. R.M.427B, the other from Foseco, Argentina, was only lacking in respect of size grading.

(j) Konserver.

This is a competitive product for addition in the cold-set furane resin sand process. Its chief attribute is in water proofing cores but in view of the fact that the $\frac{1}{2}\%$ addition replaces some of the resin, it has economic value also. It is being examined together with other materials which might do the same job. Results are not yet available.

(k) Profax - Fabrex.

Foseco, Japan, have experienced serious stripping problems with

with their Profax. Samples were examined and found to exhibit some slagging tendency. From permeability measurements it was felt that the filler might be a little too coarse and could result in localised cracking. Contraction at 600°C was rather high.

Fabrex from Foseco, Spain was examined. Dry and green strengths were down by comparison with U.K. E.P.2311. Increased resin and decreased wood flour contents were suggested.

(1) Dycote 42 - Japan.

Blowing troubles from Dycote (Chilcote) 42 on iron chills in the roll-making industry appear to have prompted Foseco, Japan, to enquire about gas evolution from their product. Samples of the product have been examined in this respect together with raw materials. Gas evolution was higher than for U.K. Dycote 42, and the nature of the R.M.304 was deemed likely to be the cause. It was not, however, positively concluded that gas evolution was dangerously excessive and technique of drying was suggested likely to be inadequate.

(m) Ferrux Evaluation - France.

Seven Ferrux type samples were evaluated from Foseco, France from the insulation and fume evolution aspects, particularly the latter. An order of merit was established.

COMPETITIVE PRODUCTS

Fourteen competitive products were analysed during the month. Twenty-nine miscellaneous samples were also dealt with.

Two Rimrite rimming agents from America and Australia were found to contain iron oxide, fluorspar, sodium cryolite, sodium nitrate and a small addition of metallic aluminium.

The only product competing with Profax which was analysed this month was a hot-top manufactured in America by Gilliam Packaging. Although of orthodox exothermic composition, this product was stated to be cheaper than Profax.

Exotherm grade A, a hot-topping compound manufactured in South Africa by Foudrex, was stated to be causing severe competition to the various grades of Ferrux. An Amitec assessment of this material showed that it gave a very rapid and hot reaction, but this reaction was not prolonged. As fluorspar is the only source of fluorine and appreciable

amounts of sodium nitrate and sodium sulphate were present, this is not surprising. The main exothermic reactions are the uncontrolled, direct reactions between aluminium and the alkali nitrate and sulphate.

Exomold MLD-R, the latest light-weight resin bonded exothermic material from the Exomet Corporation, contained the usual ingredients favoured by this manufacturer; I.R. spectron analysis indicated that the resin was a partially solubilised phenolic novolac without an addition of hexamine.

Other materials analysed this month were as follows:

1. A flux for aluminium alloys from Italy which is stated to dress off satisfactorily as low as 620°C.
2. Four Japanese mould dressings which are in competition with Terracote 46.
3. Coremol, a water-based zircon paste from America. This was competing with Terrapaint 55.
4. An Archer-Daniels-Midland mudding compound from Fosco Inc.
5. An insulating sleeve prepared from perlite and calcined alumina and also submitted by Fosco Inc.
6. A combined wetting agent and pickling inhibitor obtained in Italy by Mr. D.W. Leonard.

MISCELLANEOUS

Metallurgical Laboratory.

Number of Customer Service items received	14
Number of Customer Service items completed	12
Number of Metallurgical Reports issued	6
Number of Analytical Reports issued	1
Number of Outstanding items	8
Date of oldest outstanding item	13.3.65
Number of Internal Service items received	41
Number of Internal Service items completed	47
Number of Internal Service items outstanding	10
Date of oldest outstanding item	10.3.65

Metal Analysis.

124 samples were analysed this month. 63 of these were internal service, 17 customer service and 44 competitive products or miscellaneous samples. 19 samples were examined by X-ray diffraction and 52 spectrographically. The analysis of Briggs deoxidant was completed.

Analytical Development.

X-Ray Diffraction.

The generator broke down early this month and cannot be readily repaired. A Raymax 60 generator has been ordered and arrangements made to use the generator at the C.A.T., Costa Green until the new one arrives.

Spectrograph.

The calibrations for white and grey iron have been checked. A procedure for the determination of niobium in steel has been developed.

Coloured Marking Crayons for High Temperature Application - Fosco (F.S.) Limited.

Samples of micronised barytes, titania and mica have been evaluated and are showing some promise.

A sample of polypropylene melting at 150°C has been located and a quantity ordered for trial purposes. This material is considerably cheaper than the polyethylene at present being used and with its higher melting point is suitable in the formulation of the higher temperature sticks.

Production of the E.P.2711 series (marking crayons suitable up to temperatures of 750°C) has been fairly successfully carried out in the laboratory mixing rooms.

Development of Improved Pattrex 3 with built-in resin binder - Fosco (F.S.) Limited.

This plaster has now been designated E.P.2721/PT. A further 1-cwt. has been ordered by Barton Conduits Limited following their success of the sample previously evaluated.

Non-Exothermic Bulk Mixes - Fosco Inc.

Detailed examination on some batches of dry mixes indicates that incomplete mixing was being obtained in the "3,000 lb" vacuum blender. As a result of this finding, a survey has been made of all materials which have

been blended in this blender, and recommendation has been made to revise batch weights. In some instances, this reduction in weight amounts to 50% of the quantity previously mixed. The possibility of this problem arising again has been eliminated by insisting that no batch weights are assigned to new formulations without an initial determination of the powder density on an experimental basis.

NO REPORTS WERE ISSUED DURING THE
PERIOD - 1ST APRIL - 30TH APRIL, 1965.

WOA/DMH
14th June, 1965.

W.O.ALEXANDER.

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